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THE MARINE FISHERIES INFORMATION SERVICE: Technical and Extension Series envisages the rapid dissemination of information on marine and brackish water fishery resources and allied data available with the National Marine Living Resources Data Centre (NMLRDC) and the Research Divisions of the Institute, results of proven researches for transfer of technology to the fish farmers and industry and of other relevant information needed for Research and Development efforts in the marine fisheries sector.

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Front cover photo:

Balaenoptera musculus stranded at Tirur beach on 18-10-1986 (total length 13 m)

Back cover photo:

A live *Sousa chinensis* caught in the gill net operated off Calicut

THE MARINE MAMMALS OF INDIA

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Introduction

The marine mammals are one of the important biotic constituents of marine environment. Hershkovitz (1966) has reported 87 species of cetaceans from all the world oceans. The marine mammals of India are comprised of whales, dolphins and dugongs. They are represented by 21 species. Our information regarding the cetaceans are restricted mainly to the strandings and occasional observations on their behaviour. As the Indian Ocean is declared as a sanctuary for the whales, the study of whales and dolphins, some of which are declared as endangered species, has attracted international attention. Many countries have intensified their research on the whales and dolphins of the Indian Ocean. The study of the sirenians (dugongs) has also received international importance due to their endangered status.

Larger cetaceans also require special attention as some of the species like the sperm whale *Physeter macrocephalus* frequent the Indian and Sri Lankan coasts on its migration towards the southern part of the Indian Ocean for breeding. Alling *et al.* (1982) basing their centre of observation in Colombo, Sri Lanka, have carried out extensive research on the species. James and Soundararajan (1982, 1984) studied the osteology of the sperm whale and summarised the stranding of whales along the Indian coasts. However, there are vital areas on the biology of the whales which require immediate attention.

Though there is no fishery for the dolphins and whales along the Indian coasts, the smaller cetaceans like dolphins and porpoises are caught in large numbers in the gill nets. Recently, Mohan (1985a) has pointed out that about 30-40 dolphins are caught along the Calicut coast annually by the gill nets though there is no definite statistics available. Cochin, Calicut, Malpe, Karwar, Goa and Bombay are some of the centres where dolphins are caught in good numbers.

The same species occurring along the Indian coasts has been referred to by various authors by different names due to the lack of any osteological studies on the species. Mohan (1985b) has studied the comparative osteology of the dolphins and came to the conclusion that the commonly occurring dolphins of the Indian coasts are *Stenella longirostris* Gray, *Tursiops truncatus aduncus* Ehrenberg, *Delphinus delphis* Linnaeus and *Sousa chinensis* (Osbeck).

The position of the dugongs along the Indian coasts is alarming as indicated by the recent reports (Silas and Fernando, 1985). Though dugongs have been declared as an endangered species they are caught in Gulf of Mannar and Palk Bay. The efforts taken by the Tamil Nadu State Fisheries Department to stop their capture have not succeeded so far. No detailed scientific investigation has been carried out on the species regarding the population dynamics, reproduction and other vital biological parameters. Our information on the species is mainly on its seasonal occurrences (Mohan, 1980), food and feeding habits, behaviour in captivity and osteological features (Jones, 1967; Nair *et al.*, 1975; James, 1979). It may be stated that the population dynamics of the dugongs found along the coast of northern Australia and Madagascar coasts has been investigated in detail (Ligon, 1976; Anderson, 1980). It is essential that such studies are undertaken so as to evolve meaningful conservation measures to safeguard the species from extinction.

CLASSIFICATION OF CETACEANS

Order : Cetacea
  Sub-order : Mysticeti (Baleen whales)
    Family : Balaenopteridae
      Balaenoptera musculus Linnaeus
      Balaenoptera acutorostrata (Lacepede)
      Balaenoptera physalus Linnaeus
      Balaenoptera borealis Lesson
      Megaptera novaeangliae Borowski

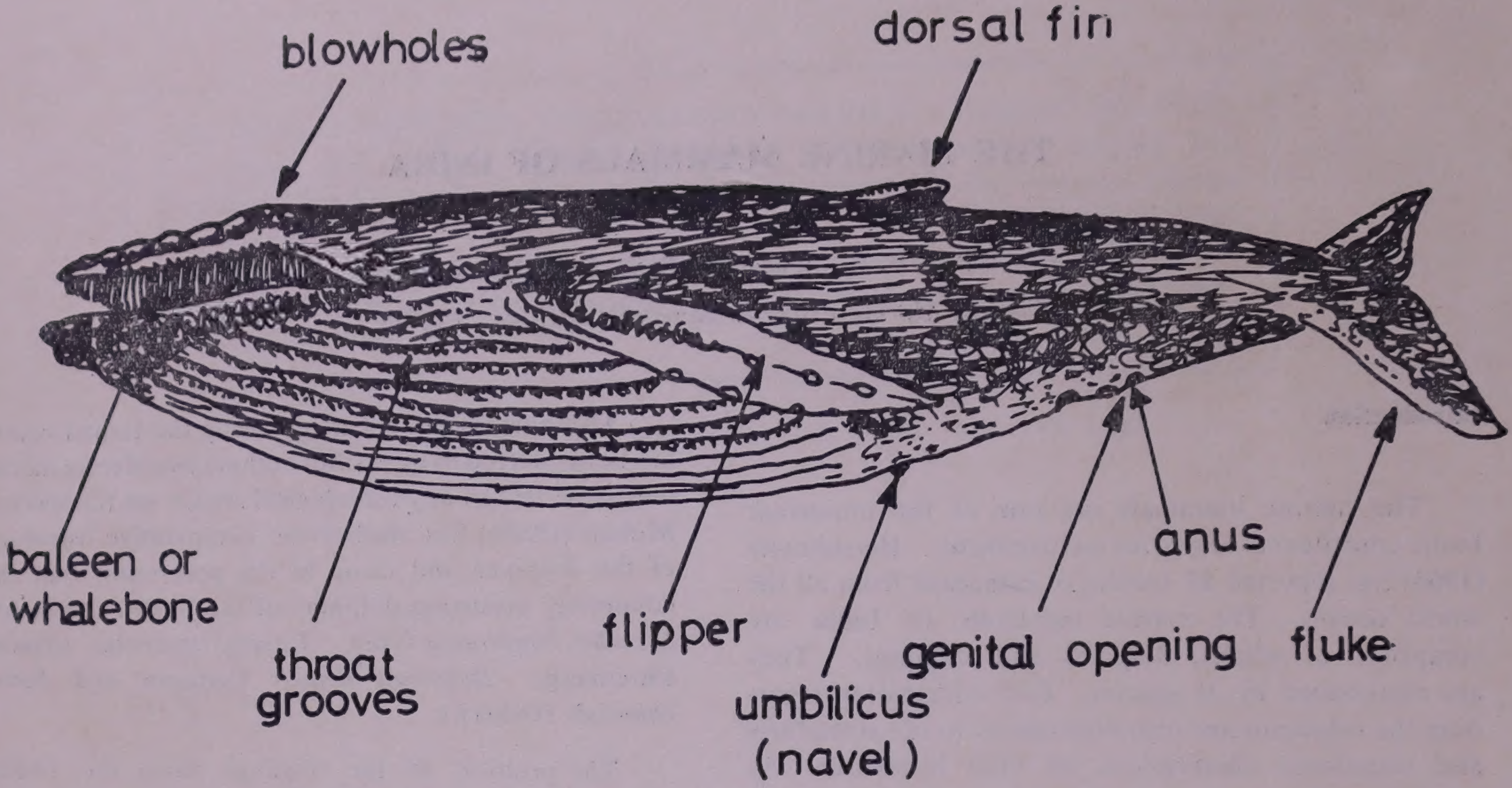

Fig. 1. Diagnostic characters of a whale.

Family : Balaenidae
Eubalaena glacialis Muller
Sub-order : Odontoceti (Toothed whale)
Family : Physeteridae
Physeter macrocephalus Linnaeus
Kogia breviceps Blainville
Family : Hyperodontidae
Ziphius cavirostris G. Cuvier
Family : Delphinidae (Dolphins and Porpoises)
Neophocaena phocaenoides G. Cuvier
Orcinus orca Linnaeus
Grampus griseus G. Cuvier
Pseudorca crassidens Owen
Orcella brevirostris Gray
Globicephalus macrorhynchus Gray
Tursiops truncatus aduncus Ehrenberg
Sousa chinensis Osbeck
Stenella longirostris (Gray)
Delphinus delphis Linnaeus
Family : Susuidae
Platanista gangetica (Ruxburgh)
Order : Sirenia
Family : Dugongidae (Dugongs)
Dugong dugon (Muller)

Brief descriptions of the commonly occurring marine mammals along the Indian coasts with their salient features are presented below to facilitate field identification. Please refer to Fig. 1 for diagnostic characters of a whale.

1. *Balaenoptera musculus* **Linnaeus (Blue whale)** (Fig. 2 & front cover photo)

Throat grooves 80–100, extending to umbilicus; baleen plates jet black; flippers whitish below and grey above.

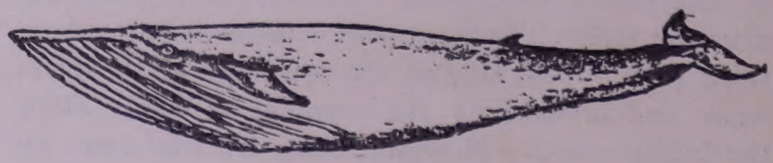

Fig. 2. *Balaenoptera musculus* Linnaeus (Blue whale).

Feeds on euphausiids and shrimps. Breeding season from February to March, gestation period 9 to 10 months. Reaches a maximum length of 26 m.

Distributed in Arctic, Antarctic, Pacific and Indian oceans, but found in more numbers north of 35° N; recorded along the coasts of India by its strandings (along the coasts of Bengal, Gujarat, South Kanara and Tamil Nadu).

2. *Balaenoptera acutorostrata* **Lacepede (Minke whale)** (Fig. 3)

Dorsal fin small, markedly falcate, curved backwards; usually greyish black above and whitish below; flipper with a prominent white band; baleen plate white with a black streaking.

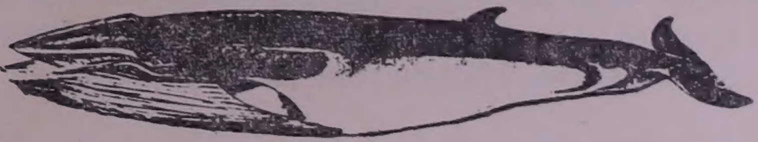

Fig. 3. *Balaenoptera acutorostrata* Lacepede (Minke whale).

Feeds on copepods, krill *(Euphausia superba)* and other zooplankton like *Calanus tonsus* and the anchovies like *Engraulis mordex*. Present estimate of this species about 3 lakhs (Ohsumi and Masaki, 1974).

Calving interval slightly more than a year; length at birth 2.8 m; gestation period about 10 months; pairing season extends from December to May in North Atlantic, January to June in North Pacific and spreads over a very long period in southern hemisphere; lactation period about 6 months; grows to 9 m in length.

Distributed in North Atlantic, Arctic and Indian oceans; in India recorded from strandings at Tuticorin (Gulf of Mannar).

3. *Balaenoptera physalus* **Linnaeus (Fin whale)** (Fig. 4)

Throat grooves 50 to 90, extending to umbilicus; body greyish black above and white below; flipper uniformly grey dorsally, white ventrally; dorsal fin small, falcate.

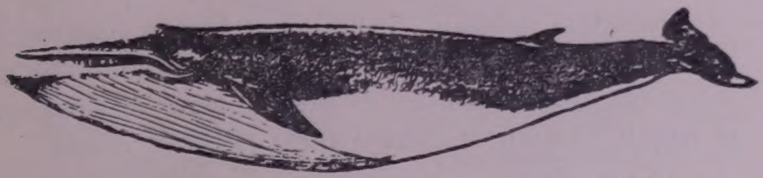

Fig. 4. *Balaenoptera physalus* Linnaeus (Fin whale).

Feeds on krill and anchovies. Length at birth about 7 m; sexually matures at 3rd year at about 20 m; pairing season extends to seven to eight months, peak season May to August; period of gestation about a year; reproductively active upto 20 years and sexually at its peak at 10 years; occurs in schools of 200 to 300 in numbers; grows to 24 m in length.

A highly hunted whale especially in northern Pacific and Antarctica. Once abundant in Nova Scotia and around New Foundland and Labrador.

Distributed in Atlantic, Pacific and Indian oceans from Equatorial waters towards northern and southern hemispheres. In India reported by its strandings from Bombay and Surat (James, 1983).

4. *Balaenoptera borealis* **Lesson (Sei whale)** (Fig. 5)

Throat grooves 32–60, distinct and terminating about half way between tip of flippers and umbilicus; baleen plates black but a few partly white; body grey to bluish grey above; dorsal fin deeply concave on the posterior margin; flippers usually small and measures about 1/4 of the total length; grows to 19 m in length.

Feeds on sardines, euphausiids and copepods. Breeds in early spring but mating is performed all through the year; gestation period for 10–11 months.

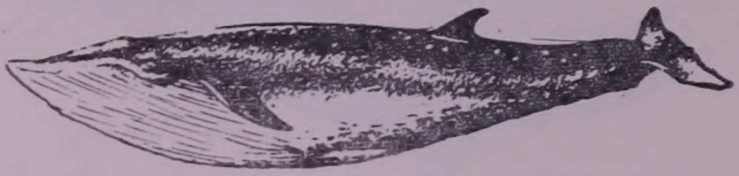

Fig. 5. *Balaenoptera borealis* Lesson (Sei whale).

Distributed in all the oceans of the world; most abundantly found in Norwegian coast. Population off South Africa depleted due to increased fishing. The skeleton of a specimen measuring 13 m, stranded at Dhanushkodi Island in 1983 was collected by R. S. Lal Mohan and kept in Regional Research Centre of CMFRI, Mandapam Camp; reported from Palk Bay also.

5. *Megaptera novaeangliae* **Borowski (Humpback whale)** (Fig. 6)

Throat grooves 19 to 20, extending from chin to navel; body stockier than the other whales; flipper long and black dorsally and white ventrally and measures 1/4 to 1/3 of the total length; irregular knobs and protuberances on head and flippers; dorsal fin small; whale bone grey-black or white; grows to 16 m in length.

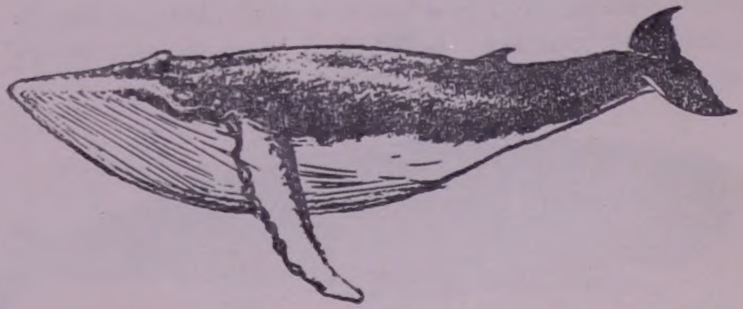

Fig. 6. *Megaptera novaeangliae* Borowski (Humpback whale).

Feeds mainly on krill and fishes. Calving and pairing takes place in winter; migrates to warmer waters for breeding. Length at birth about 5 m. Depleted in all the oceans and particularly vulnerable due to slow swimming behaviour. A widely distributed species occurring in all oceans; often seen along coastal waters; recorded from Kerala coast.

6. *Eubalaena glacialis* **Muller (Black right whale)** (Fig. 7)

The baleen plates much longer than in other species; upper jaw with a few horny protuberances; throat grooves and dorsal fin absent; grows to 16 m in length.

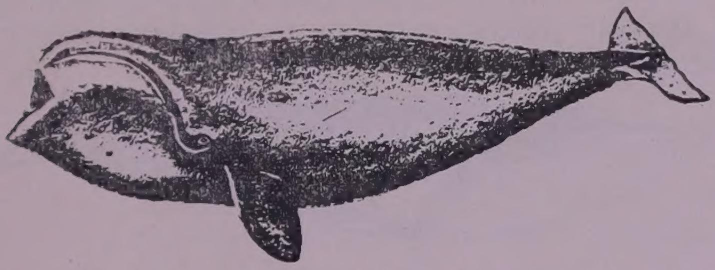

Fig. 7. *Eubalaena glacialis* Muller (Black right whale).

A much hunted species, population depleted in many areas; abundant before 150 years in southern hemisphere but later ruthlessly exploited in South Atlantic and Pacific seas. During 1846 to 1851, 300–400 whaling ships engaged in pursuit of these whales. A protected species according to International Whaling Commission.

Distributed in Atlantic, Pacific and Indian oceans.

7. *Physeter macrocephalus* **Linnaeus (Sperm whale)** (Fig. 8)

Resembles a gigantic tadpole with head forming massive conspicuous part of body; lower jaw weak and disproportionately small with 18–28 large and powerful teeth on each side. No teeth on upper jaw; dorsal fin absent and replaced by a series of low ridges. Flippers broad and rounded. Body black dorsally and silvery grey ventrally. Grows to 21 m in length.

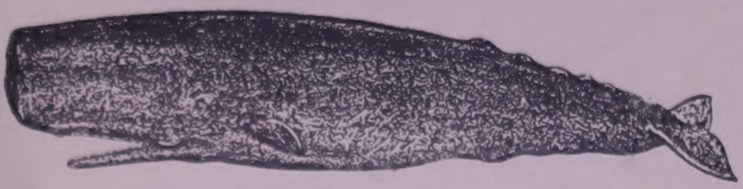

Fig. 8. *Physeter macrocephalus* Linnaeus (Sperm whale).

Feeds on squids and fishes. Period of gestation about 10 to 12 months; length at birth about 4 m. A much hunted whale. There are about 2,000 sperm whales in North Atlantic. In North Pacific its population is 50% above the maximum sustainable yield.

Widely distributed throughout great oceans though prefers warm waters of tropical and sub tropical regions. Reported from Madras, Pamban, Manauli Island, Krusadi Island, Mangalore and Karwar coasts.

8. *Kogia breviceps* **Blainville (Pygmy sperm whale)** (Fig. 9)

Body black above and greyish white below; dorsal fin small and falcate; flippers smoothly curved on forward margin and located well anteriorly; body extremely robust and rapidly tapering near the tail; head more or less square in shape; lower jaw narrow and inferior in position, located well behind tip of snout; grows to 3.5 m in length.

Feeds mostly on cephalopods and fishes. Occurs in small schools of three to six individuals. Hunted with hand harpoons along Japanese coast at the rate of three to six every year.

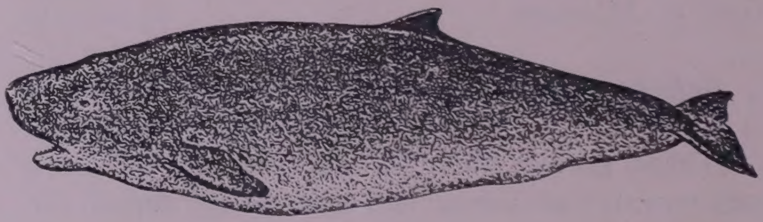

Fig. 9. *Kogia breviceps* Blainville (Pygmy sperm whale).

Found in Atlantic, Pacific and Indian oceans; in temperate and tropical waters. Not a common species along the Indian coast. A pregnant *Kogia breviceps* of length 3 m reported from India (Waltair coast).

9. *Ziphius cavirostris* **G. Cuvier (Cuvier's beaked whale)** (Fig. 10)

Beak short; body purplish black above, brown on sides and white below; dorsal surface of head behind beak slopes backwards at an oblique angle from snout; distance from tip of snout to blowhole about 1/10 of total length; teeth not usually visible in females; often 20–30 teeth found in very young animals; characterised by a single pair of teeth on jaw in adult males; grows to a length of 7 m.

Feeds mainly on squids and deep sea fishes. Size at sexual maturity of male about 5.4 m and that of female about 6.1 m; length at birth 2 to 3 m.

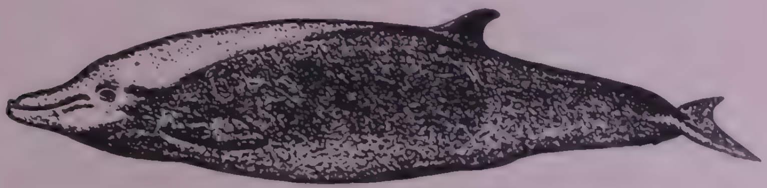

Fig. 10. *Ziphius cavirostris* G. Cuvier (Cuvier's beaked whale).

Primarily an oceanic form found in groups of three to five animals; taken in small numbers along the Japanese coast. According to Nishwaki (1972) annual catch of the species from 1965 to 1970 ranges from 13 to 16. No information is available on its stock position. A widely distributed cetacean; reported from coasts of Europe, America, Africa, Australia and Japan; known from Lakshadweep islands.

10. *Neophocaena phocaenoides* **G. Cuvier (Black porpoise)** (Fig. 11)

Forehead rounded and almost protuberant in profile; dorsal fin absent; minute tubercles or horny scales present dorsally; body black except for dark grey patches between flippers; teeth conically spade-shaped unlike conically pointed teeth of dolphins; 15–19 teeth on each side of upper and lower jaws. Grows to a length of 1.8m.

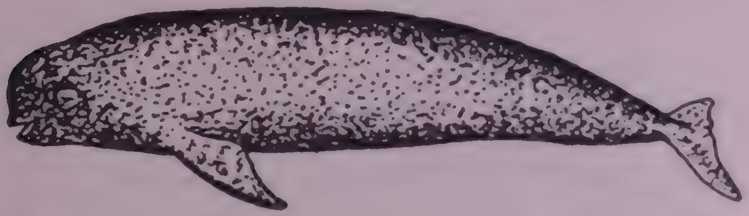

Fig. 11. *Neophocaena phocaenoides* G. Cuvier (Black porpoise).

Feeds on small squids, shrimps and fishes. Males somewhat larger than females. The young born around October. Indo-Pakistan sub-species are known as *Neophocaena phocaena phocaenoides* and Sino-Japanese sub-species is known as *Neophocaena phocaena asiaeorientalis*. Found in small groups of 40 to 50; subdivided into 5–10 animals. Accidentally caught in the gill nets along the Indian coasts.

Distributed from Cape of Good Hope to Japan. In China ascends to Yangtesee River to nearly 1,400 km from sea. It is abundant along the coast of Bombay and tends to frequent rivers and estuaries. In India reported from all along the coasts.

11. *Orcinus orca* **Linnaeus (Killer whale)** (Fig. 12)

Body stream lined; flippers rounded; dorsal fin conspicuous, situated almost midway; flipper length about 1/9 of the body length in young animals and 1/5 in old animals; colour well marked and distinctive; dorsal surface black, belly white; an oval white patch on sides of head just above and behind eye; chin white, lateral white patch a very constant feature; 10 to 12 large powerful conically pointed teeth on each side of upper and lower jaws; attains 9 m in length.

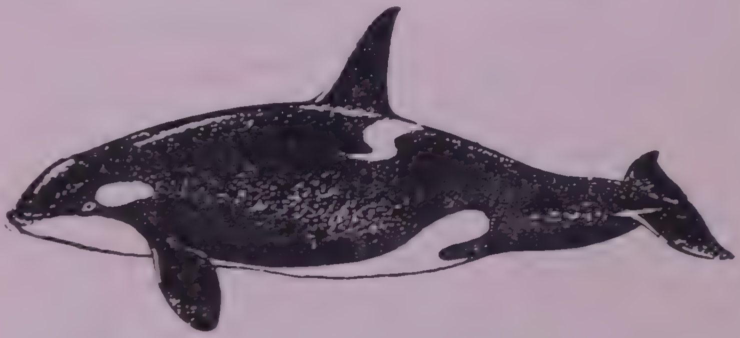

Fig. 12. *Orcinus orca* Linnaeus (Killer whale).

Feeds on fishes, cephalopods, birds, larger marine mammals and turtles. Gestation period about 12 months; female sexually matures at about 5 m length; male matures at 6.7 m. The length at birth about 2.5 metres; fully grown male about double the size of the female; killer whales travel in groups; exhibit a high degree of group hunting co-operation particularly in feeding on large marine mammals. Easily trained in captivity and shown in oceanaria. Distributed in all seas from Arctic to Antarctic; more common in cooler waters. In India recorded from Okhamandal in Gujarat coast.

12. *Grampus griseus* **G. Cuvier (Risso's dolphin)** (Fig. 13)

Body robust, head bulbous, flipper long pointed. Body light grey to dark, scarred with numerous scratches; not beaked: forehead vertically creased in centre; dorsal fin less than 38 cm, erect and distinct; fluke deeply notched. Teeth three to seven pairs on lower jaw only.

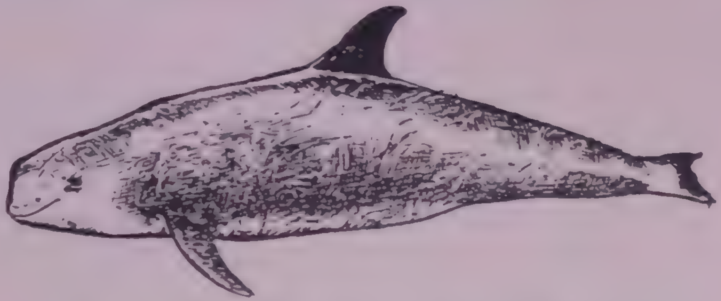

Fig. 13. *Grampus griseus* G. Cuvier (Rissos dolphin).

Feeds on fishes and squids. Longivity about 24 years. Males attain sexual maturity at 3 m length. Maintained in captivity.

Large schools have been seen in Newfoundland; form a small–scale fishery in Newfoundland, Antilles, Japan and Indonesia. An oceanic species distributed in North Atlantic, Mediterranean, Coast of Newfoundland and Cape of Good Hope. Reported from the coast of Sri Lanka.

13. *Pseudorca crassidens* **Owen (False killer whale)** (Figs. 14, 30)

The body elongate and slender. Head narrow. gently tapering from blowhole forward. Snout projects a little beyond the tip of lower jaw; dorsal fin small, tip directed backwards, with posterior border concave. Flippers tapering, characterised by a broad hump in the front margin near the middle, about 1/10 of the body length. Body entirely black, teeth large, pointed with 8 to 11 pairs in upper and lower jaws. Attains a length of 5.5 m.

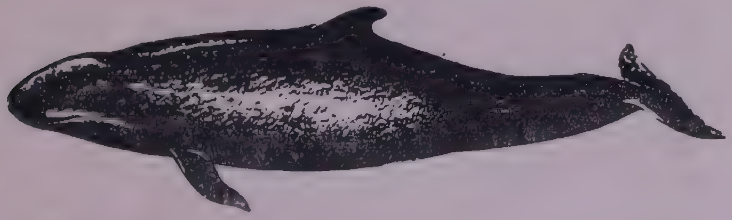

Fig. 14. *Pseudorca crassidens* Owen (False killer whale).

Feeds mainly on fishes and cephalopods. Attains maturity at 4.25–4.5 m; breeding season fairly extensive. Not hunted but about 30 to 50 taken annually in tuna long line fisheries in the Pacific.

Distributed in Atlantic, Pacific and Indian oceans. In India recorded from Cape Comorin, Tiruchendur, Madras, Trivandrum, Pozhikara (Kanyakumari District) and Calicut.

14. *Orcella brevirostris* **Gray (Irrawaddy dolphin)** (Fig. 15)

Head convex from blowhole to upper tip; mouth horizontal. Flippers long, broadly triangular, two times its breadth; centre of dorsal fin behind middle of body. Dorsal fin small, falcate with rounded ends. 12 to 19 teeth on each side of upper and lower jaws; small and sharply conical in young animals; flat in older animals. Attains a length of 2.4 m.

Feeds on fishes and crustaceans. The length at birth about 0.8 m. No information on the statistics of the stock or the possible future exploitaion; kept in captivity successfully.

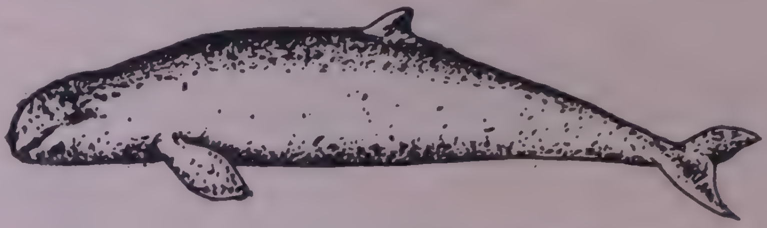

Fig. 15. *Orcella brevirostris* Gray (Irrawaddy dolphin).

Distributed from Bay of Bengal to North Australia and coast of Indo–China; enters large rivers and can live permanently in fresh water; found to ascend nearly 900 miles up in the Irrawaddy river. In India reported from Waltair coast (Norman and Fraser, 1937).

15. *Globicephalus macrorhynchus* **Gray (Short-finned pilot whale)** (Fig. 16)

The head somewhat thick and bulbous. In old males the forehead overhangs the mouth to several inches. Flippers 1/16th of the body length or less and sickle shaped. Tail dorso-ventrally thickened in front of fluke; dorsal fin low. Body colour almost entirely black; 7–9 teeth on each side of upper and lower jaws and confined to front portion of the jaws. Attains 5.3 m.

Feeds mainly on fishes Female attains sexual maturity at 3.0 to 3.2 m and male at 3.8 m; calving interval about three years; length at birth about 1.4 m; extended breeding and calving season; kept in captivity successfully.

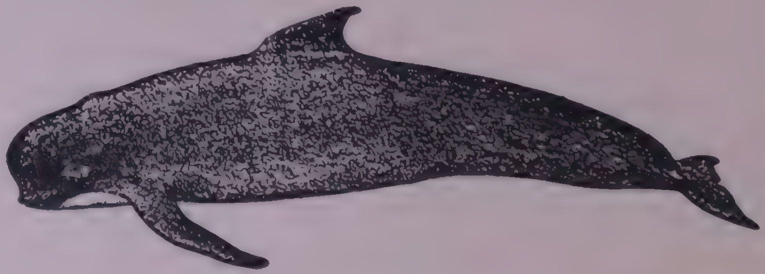

Fig. 16. *Globicephalus macrorhynchus* Gray (Short-finned pilot whale).

Caught in large numbers along the South American coast. Nearly 3,000 caught annually in early 70s. Distributed in Atlantic, Pacific and Indian oceans. Mass strandings in India reported near Calcutta in 1852 and in Tuticorin (Alagarswami *et al.*, 1973).

16. *Tursiops truncatus aduncus* **Ehrenberg (Bottle-nose dolphin)** (Figs. 17, 25)

Characterised by a long well defined snout and a bulbous forehead. Dorsal fin broad at base, tail falcate. Flippers moderate in size, tapering to a point. Teeth numbering 24 to 28 on each side of upper and lower jaws. Colouration usually dark grey-brown on the back and light grey on the belly. Larger specimen pigmented on the ventral side. Grows to 3.7 m in length.

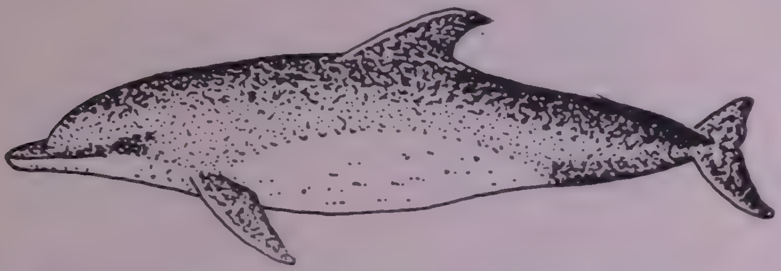

Fig. 17. *Tursiops truncatus aduncus* Ehrenberg (Bottle-nose dolphin).

Feeds mainly on inshore fishes like sardines and mackerels. Age at maturity ranges from 5 to 12 years in females and 10 to 12 years in males; females attain sexual maturity at 2.2 to 2.4 m and males 2.5 to 2.6 m. Calving interval about two years, longivity about 25 years; length at birth 1.0–1.2 m; gestation period about 12 months, pregnant females recorded from Calicut (Mohan, 1982); easily caught and trained in the oceanaria. Caught in large numbers in live-capture fisheries in U.S.A., Japan and Adriatic Sea. Small numbers caught in West Africa, Sri Lanka, India and Indonesia. More than 2,000 taken in the tropical Pacific tuna fishery.

Distributed in Indian, Pacific and Atlantic oceans. Recorded from all along Indian coasts with more numbers along the west coast between Bombay and Trivandrum; occurs as an incidental catch in gill nets.

17. *Sousa chinensis* **(Osbeck) (Hump-back dolphin)** (Figs. 18, 23, 24 and back cover)

Beak long and forehead bulbous; characterised by a hump on its back; dorsal fin with a little elevation and posterior border feebly indented; flippers recurved and distinctly broad at base. 34 to 37 teeth on each side of upper and lower jaws. The colour uniformly lead grey; longitudinal blotches on ventral side in larger specimens; grows to 3.2 m.

Feeds mainly on fishes; kept in captivity in oceanaria in Australia; once kept in a polyethylene lined pond at Calicut (Mohan, 1983). Found to migrate to estuaries in search of food; a pregnant female recorded from Calicut (Mohan, 1982).

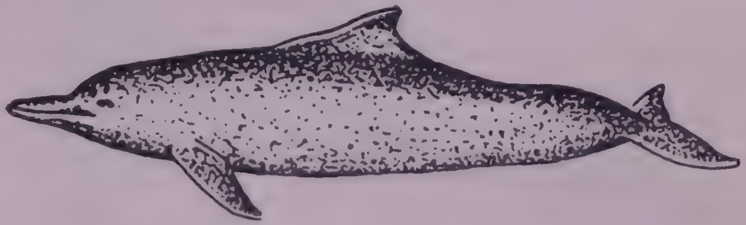

Fig. 18. *Sousa chinensis* (Osbeck) (Hump-back dolphin).

Distributed from Cape of Good Hope to coast of China; occurs along the Indian coast often; caught in gill nets in Goa, Mangalore and Calicut.

18. *Stenella longirostris* **Gray (Spinner dolphin)** (Figs. 19, 27–29)

Body slender, dorsal fins moderately falcate to triangular and very erect. Tip of snout distinctly black and dark grey to black dorsally; yellowish brown laterally and white ventrally. 44–51 teeth on each side of upper and lower jaws. Teeth small, slightly curved inward. Occurs in herds of several hundred individuals; seen jumping over the waves. Attains a length of 2.5 m.

Feeds mainly on pelagic fishes and squids. Length at birth about 0.8 m. Females usually give birth to a single calf. Successfully maintained for several years in oceanaria; considered as an indicator species of tuna schools; caught in tuna purse seines; about 50,000 caught in early 1970's as incidental catches in the tuna fishery in Pacific. About 40 dolphins caught in the gill net fishery annually at Calicut coast during 1976–1980 (Mohan, 1985).

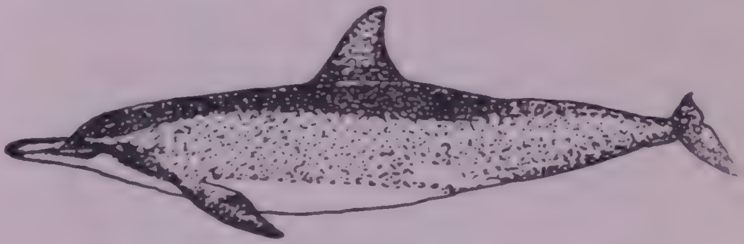

Fig. 19. *Stenella longirostris* Gray (Spinner dolphin).

Distributed in Atlantic, Pacific and Indian oceans. Reported along the Indian coasts.

19. *Delphinus delphis* **Linnaeus (Saddle-back dolphin)** (Fig. 20)

Characterised by a well defined narrow beak and with distinct colourations. Beak acute than *Tursiops* *aduncus.* Dorsal fin moderately developed and tapers backwards with a concave hind margin. Flippers moderate in size, tapering; body black dorsally, lower surface white, upper and lower jaws with 62–65 teeth on each side; grows to 2.5 m.

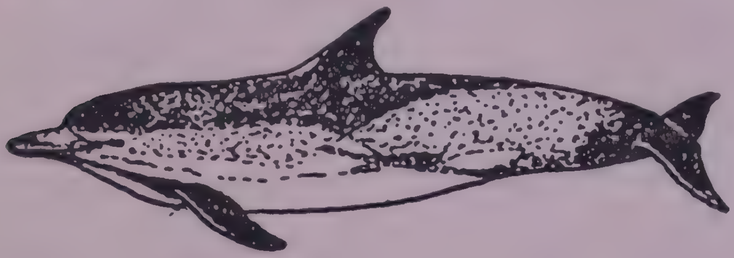

Fig. 20. *Delphinus delphis* Linnaeus (Saddle-back dolphin).

Feeds on fishes and squids, length at birth about 0.8–0.9 m. Male attains a length of about 2.5 m. Sexually matures at about 4 years. Gestation period estimated to be about 10–11 months; trained and kept in oceanaria.

Found to aggregate with tuna fishes in Pacific Ocean. Nearly 10,000 dolphin killed incidentally in the tuna fishery of eastern tropical Pacific (Leatherwood *et al.*, 1976). Distributed from east coast of Africa to Japan and along the coast of Australia. Recorded along the Indian coasts. In India caught incidentally in the gill nets in Bombay, Goa, Mangalore, Calicut and Cochin.

20. *Platanista gangetica* Roxburgh (Gangetic dolphin or Susu) (Fig. 21)

Forehead rises rather steeply to upper surface of head; snout long; dorsal fins almost ridge like. Tail flukes broad; posterior border with a notch in middle; flippers short and broad at their outer end. Eyes very small and animal almost blind. Teeth small about 28–30 on each half of upper and lower jaws. Body lead black and ventral surface pale white.

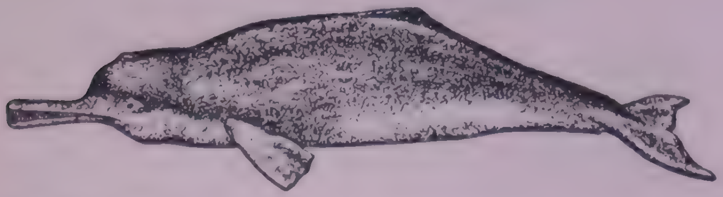

Fig. 21. *Platanista gangetica* Roxburgh (Gangetic dolphin or Susu).

Feeds mainly on fishes, shrimps and molluscs by ploughing its snout into the mud. Male attains sexual maturity at about 2.1 m and female at 2.5 m; length at birth 0.7–0.8 m. Breeding seasons from April to July; gestation period about 8–9 months.

Kept in captivity in Japan; caught incidentally in the seine nets in River Ganges. A highly endangered species and requires urgent protection. Distributed in Ganges, Brahmaputra and Karnaphuli river systems.

21. *Dugong dugon* Muller (Sea cow) (Fig. 22)

The body spindle shaped, divisible into a head, trunk and tail. Head relatively small, characterised by a muzzle, and a broad flat horse-shoe shaped extension of the upper lip which overlaps sides of mouth; large numbers of hairs and bristles on the muzzle; eyes small; dorsal fins absent; flippers round towards the end. Dentition with incisors and molars. In male incisors long and pointed. Skin of dugong thick and hairs present on the surface. Tail strengthened by a low ridge mid-dorsally and mid-ventrally and caudal fluke crescentic.

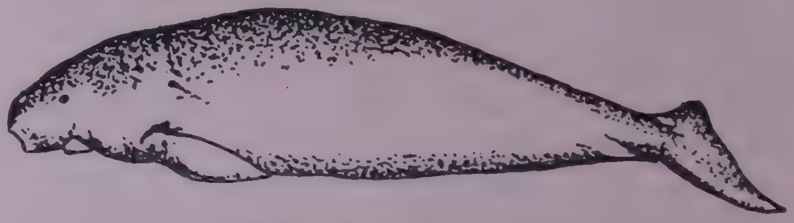

Fig. 22. *Dugong dugon* (Muller) (Sea cow).

Distributed from east coast of Africa to Japan with a concentration of population in Torres Strait along northern coast of Australia. In India, found in the Gulf of Mannar, Palk Bay, Gulf of Kutch and Andaman islands.

The size at maturity about 2.3 m in females. The length at birth about 90 cm. Dugongs are usually monogamous; grows to a length of about 3 m; longivity estimated to be ranging from 35–45 years; herbivorous animals feeding on sea grasses like *Cymodocea serrulata*, *Halophila ovalis* and *Enhalus koenigi*.

Sluggish animals inhabiting the coastal waters; benthic in habit; a voracious feeder. Once observed 25 kg of sea grass in the stomach (personal observation by Lal Mohan). Dugongs are kept in oceanaria and can be easily acclimatised. Captured by gill nets along the coast of Gulf of Mannar and Palk Bay. Considered as a delicacy along the Gulf of Mannar coast. About 20 to 60 numbers caught in Gulf of Mannar and Palk Bay (Mohan, 1980).

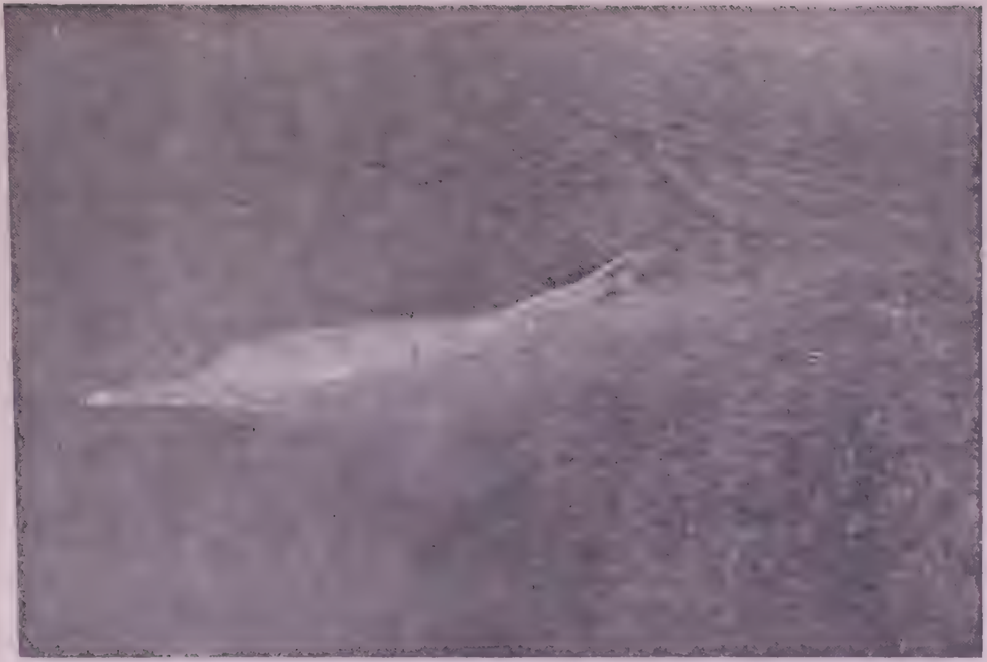

Fig. 23. *Sousa chinensis* in polythene lined pond at Calicut.

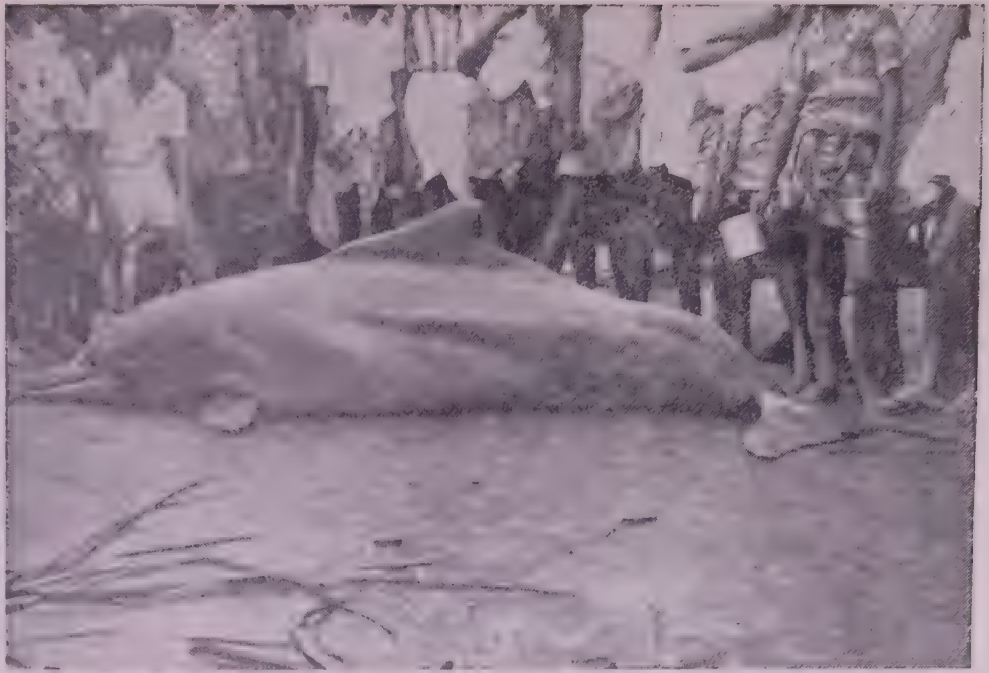

Fig. 24. *Sousa chinensis* caught in the gill net off Calicut on 2-9-'78. Male; length 2.7 m.

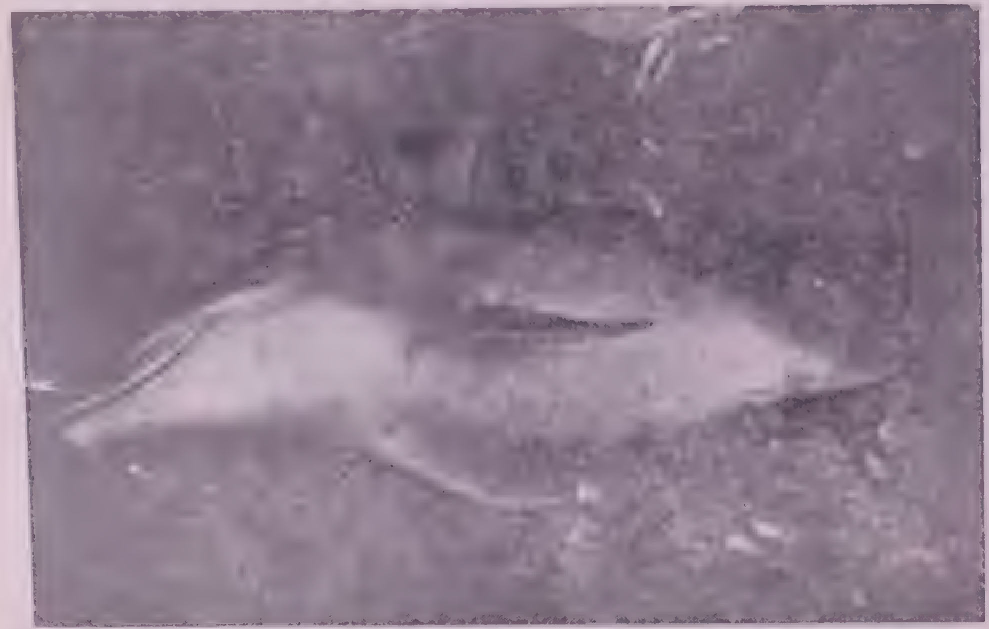

Fig. 25. *Tursiops truncatus aduncus* caught in the gill net off Calicut coast on 21-12-'78. Male; length 2.8 m.

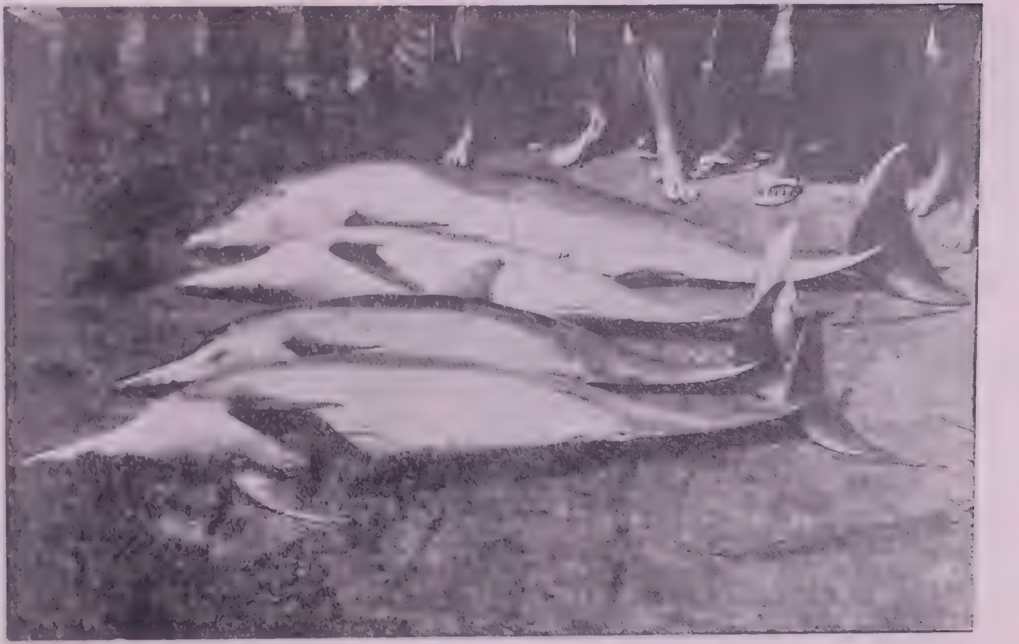

Fig. 26. By-catch of dolphins in the Calicut fish market on 11-1-'80.

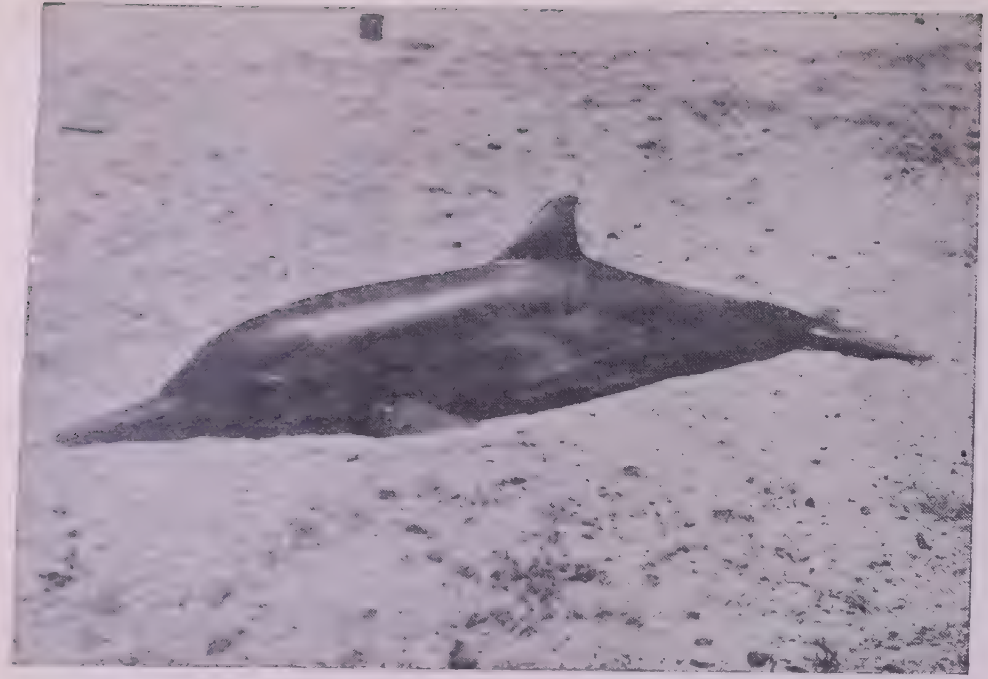

Fig. 27 Dorso-lateral view of *Stenella longirostris* caught off Calicut.

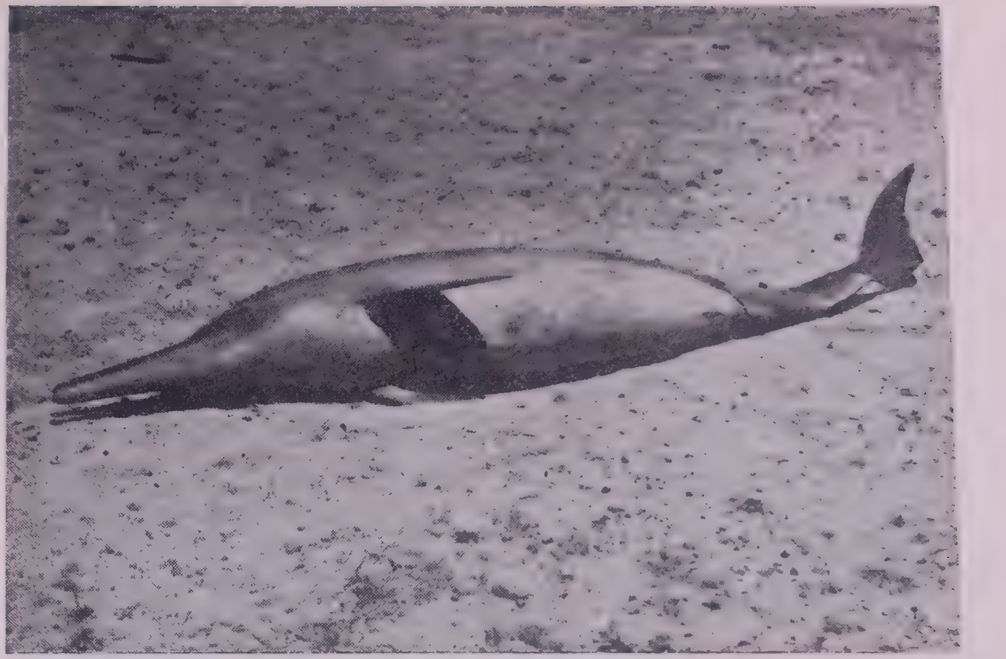

Fig. 28. Ventro-lateral view of *Stenella longirostris* caught off Calicut.

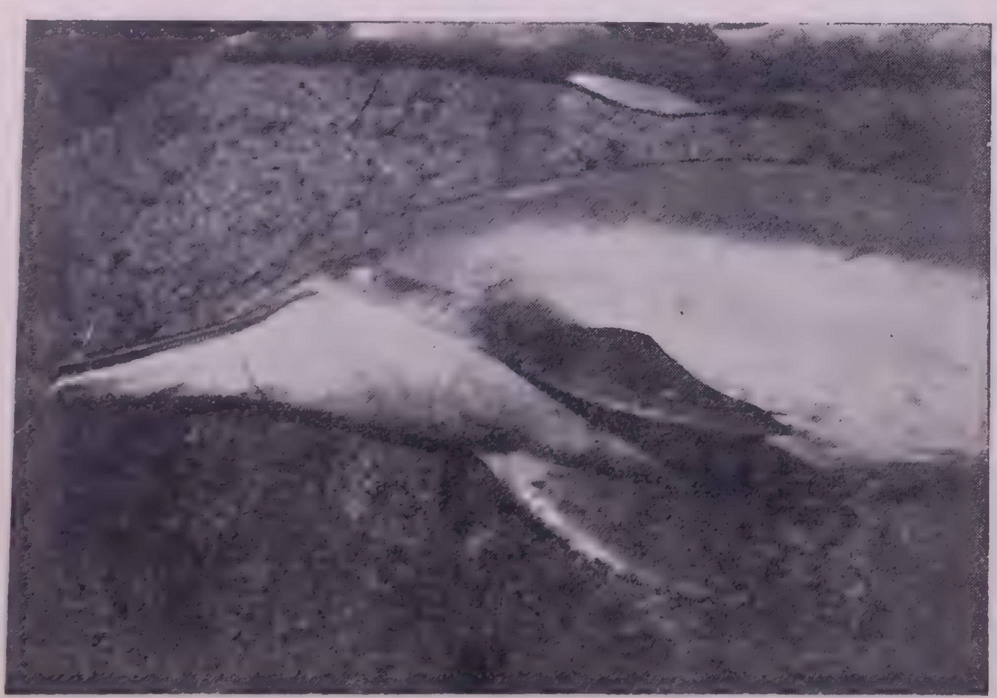

Fig. 29. *Stenella longirostris* got entangled in the gill net off Calicut on 19–9–'81. Male; length 2.1 m.

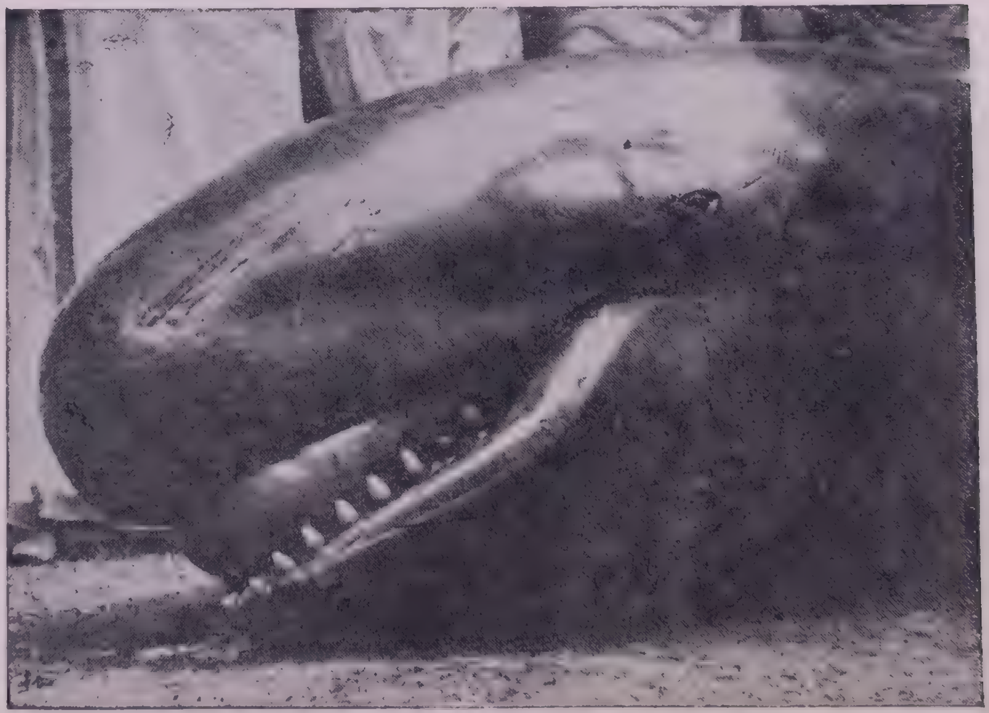

Fig. 30. *Pseudorca crassidens* landed at Puthiappa beach (Calicut) in July 1979 showing disposition of teeth on the lower jaw.

Key to the identification of marine mammals of India

1. 1a. Whale bone (baleen plates) absent; teeth present **2**
1b. Whale bone (baleen plates) present; teeth absent **16**

2. 2a. Teeth differentiated into incisors and molars; lip with well developed muzzle, dorsal fin absent ... ... *Dugong dugon* (Sea cow) (Fig. 22)
2b. Teeth uniform, not differentiated (toothed whales and dolphins) **3**

3. 3a. Teeth on lower jaw only **4**
3b. Teeth on both jaws **7**

4. 4a. Teeth strong; more than 8 pairs on lower jaw **5**
4b. Teeth strong; less than 8 pairs on lower jaw **6**

5. 5a. Teeth 9–14 pairs on lower jaw, head 1/6 of body length; head conical, upper jaw much larger than lower jaw ... ... *Kogia breviceps* (Fig. 9)
5b. Teeth 20–30 pairs on lower jaw; head massive, rectangular, 1/3 of body length; lower jaw short and smaller, upper jaw projecting; flippers rounded; dorsal fin all defined ... ... *Physeter macrocephalus* (Fig. 8)

6. 6a. Teeth 3–7 pairs on lower jaw, head bulbous, forehead with a vertical crease in centre, body with numerous scratches; flipper tappering ... ...*Grampus griseus* (Fig. 13)
6b. Teeth one pair at tip of lower jaw in large males; (young animals may have more than one pair); forehead not distinct; dorsal fin well behind mid point of body; cleft of mouth short; well marked, white bloches in adults ... ... *Ziphius cavirostris* (Fig. 10)

7. 7a. Eyes rudimentary, not functional; skull with cranial crest; beak well marked; each jaw with 26–30 pairs of small pointed teeth .. .. *Platanista gangetica* (Fig. 21)
7b. Eyes well developed, functional; cranial crest absent **8**

8. 8a. Teeth spade-like, 15–19 on each jaw; dorsal fin absent; body dark black; beak absent ... ... *Neophocaena phocaenoides* (Fig. 11)
8b. Teeth conical, pointed, 6–65 on each jaw **9**

9. 9a. Teeth 6–15 on each jaw **10**
9b. Teeth 20–65 on each jaw **13**

10. 10a. Body with large distinct white patches above the eye and base of dorsal fin; teeth strong, 10–12 pairs; dorsal fin erect and larger; flippers paddle shaped ... ... *Orcinus orca* (Fig. 12)
10b. Body without large white patches above the eye and dorsal fin **11**

11. 11a. Teeth 7–11 on each jaw; flippers tapering **12**
11b. Teeth 12–19 on each jaw; flippers paddle shaped; forehead bulbous; beak absent ... ... *Orcella brevirostris* (Fig. 15)

12. 12a. Teeth 7–10 on each jaw, flipper long, 1/5 to 1/7 of body length, forehead bulbous; outer margin of flippers without hump, dorsal fin not pointed ... ...*Globicephalus macrorhynchus* (Fig. 16)
12b. Teeth 8–11 on each jaw; flippers 1/8 to 1/10 of body length, outer margin of flippers with hump ... ... *Pseudorca crassidens* (Fig. 14)

13. 13a. Teeth 24–28 on each jaw; beak distinct; adults with grey oval spots ventrally ... ... *Tursiops truncatus aduncus* (Fig. 17)
13b. Number of teeth more than 30 in each jaw **14**

14. 14a. Number of teeth 34—38 on each jaw; base of dorsal fin extended posteriorly; a dorsal hump present ... ... *Sousa chinensis* (Fig. 18)
14b. Number of teeth more than 42 on each jaw **15**

15. 15a. Number of teeth 45–51 on each jaw, a dark grey stripe from flipper to eye ... ... *Stenella longirostris* (Fig. 19)
15b. Number of teeth 60–65 on each jaw; palate tested; dark grey band from base of flippers to base of lower jaw ... ... *Delphinus delphis* (Fig. 20)

16. 16a. Dorsal fin absent; surface of throat not grooved; chin not white; head ¼ of body; upper border of lower lip much arched; 'bonnet' on head ... ... *Eubalaena glacialis* (Fig. 7)
16b. Dorsal fin present; surface of throat grooved, upper border of lower lip not arched **17**

17. 17a. Flipper extremely long, 1/3 of body length, lower margin of flippers scalloped ... ... *Megaptera novaeangliae* (Fig. 6)

17b. Flippers less than 1/5 of body length, not scalloped below the flippers; baleen plate black, white or partially white 18

18. 18a. Baleen plates black; throat grooves 80–100 extending to at least umbilicus, length of flippers 1/7 of total length ... ... *Balaenoptera musculus* (Fig. 2)

18b. Baleen plates white or partially white; inner side of flippers white 19

19. 19a. Throat grooves about 50, extending to half way to umbilicus; flipper length 1/8 of total length ... ... *Balaenoptera acutorostrata* (Fig. 3)

19b. Baleen plates white or slate coloured; inner side of flippers white 20

20. 20a. Baleen plates black with frayed white inner edge; flipper length 1/10 to 1/12 of total length; grooves 30–60 extending midway between flippers and umbilicus... ... ...*Balaenoptera borealis* (Fig. 5)

20b. Baleen plates white along anterior third, frayed edge white; flipper length 1/9 of total length; throat grooves 60–90 extending to umbilicus; inner side of flippers white ... ... *Balaenoptera physalus* (Fig. 4)

Discussion

The marine mammals of Indian seas are attracting special attention due to the declaration of Indian Ocean as a sanctuary for the whales. Though whales and dolphins do not form a regular fishery along the coasts of India, there is no place for complacency as dolphins and dugongs are caught in the gill nets along the coasts. In the case of dolphins though the magnitude of destruction along the Indian coasts is not very high when compared to the eastern Pacific, there is all possibility that the dolphin catch may increase in the future due to the introduction of purse seines for pelagic fishes. It may be stated that in the case of dugongs though it is true that the Indian Wild Life Act 1972 has some effect on their fishing as indicated by the reduction of the number of dugong nets operated, there is still scope for better implementation of the Act. There is no fishery for the whales along the Indian coasts, and most of the records of the whales are due to its strandings. The recent studies made by Alling *et al.* (1982) show that the *Physeter macrocephalus* migrates to south of Sri Lanka for breeding and they are not disturbed in their habitats. However, close watch and vigilance are essential to safeguard the habitats of these whales.

Dugongs face serious threat as the fishing activities along the Gulf of Mannar and Palk Bay have increased recently to a great extent by the operation of the trawlers and this has affected the sea grass beds of these areas which form the main habitat for the dugongs. Naturally the destruction caused to the sea grass beds will affect the population of dugongs.

Further it will be essential to introduce animal husbandry methods and captive breeding to increase the population of the dugongs. It has been shown that they can easily be reared in captivity. However, we may have to study the reproductive behaviour in relation to ecological factors. More studies are needed in this line. Eventhough many suggestions have been made to protect the animal, no comprehensive plan of action has been initiated.

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SOME OBSERVATIONS ON DOLPHINS IN MANDAPAM AREA WITH A NOTE ON THEIR FOOD*

Introduction

The dolphins are common in the Gulf of Mannar near Mandapam. Five of them were caught by the fishermen in trawler or gill net in the neighbourhood of Krusadai Island in the Gulf of Mannar in the winter months of 1980 to 1982. They were studied for the species identity and their stomach contents. Data regarding the date, place of collection weight, sex and essential body measurements of all specimens were recorded.

Observations on school of dolphins

Sighting of dolphin in singles or in pairs in the vicinity of Krusadai Island, particularly in the channel areas during winter months is very common. When the senior author was on board the vessel Cadalmin-II, conducting trawling operation in the area (9–79/IB) in depths ranging between 20 and 22 m on 7–12–'82, 15 nautical miles from the shore, 7 numbers of dolphins were observed following the cod end of the net. On 15–12–'82, while conducting trawling operation in the same area 15 to 30 dolphins were found at the net end during all the hauls. The species was identified to be *Tursiops aduncus.* In all the three trawl hauls the silverbellies dominated with 87.2, 95.0 and 96.6% respectively.

Dolphins caught in trawl/gill nets

Three numbers of *T. aduncus* caught by the fishermen in their trawl net, one young common dolphin *Delphinus delphis* caught in a gill net operated from the non-mechanised boat and another *D. delphis* which was washed ashore just opposite to C.M.F.R.I. jetty were all brought to the laboratory to examine and study the stomach contents. The body measurements taken are given in the Table I.

On 12–11–'80 an adult dolphin (Fig. 1) measuring 182.5 cm and weighing 65 kg was caught accidentally in a trawl net while operating off Krusadi Island in the Gulf of Mannar. The colour of the specimen was black on the dorsal side and greyish white on the ventral side. The lower jaw was somewhat longer than the upper, and number of teeth on the upper jaw on one side was 25 and 24 on the lower jaw. It was identified as a male of *T. aduncus.* The stomach was cut open and found that the food was in a digested condition. The length of the small intestine measured 4.5 m.

On 26–11–'81 another adult specimen was caught in a trawl net while fishing at night (Fig. 2). It resembled the first one in colour and in the number of teeth.

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*Prepared by S. Krishna Pillai and C. Kasinathan, Regional Centre of CMFRI, Mandapam Camp.

Table 1. *The morphometric measurements (cm) of* Tursiops aduncus *and* Delphinus delphis *caught in Mandapam during winter months*

1. Name of the species	*T. aduncus*			*D. delphis*	
2. Date of capture	12–11–'80	26–11–'81	8–12–'81	20–2–'82	8–12–'82
3. Total length (snout to notch of caudal flukes)	182.5	210.5	143.0	145.0	159.0
4. Tip of the snout to blowhole	30.0	34.0	24.5	29.0	30.5
5. Tip of the snout to centre of eye	30.4	34.5	24.0	29.5	29.5
6. Tip of the snout to anterior insertion of flipper	45.7	53.0	37.5	39.5	43.0
7. Tip of the snout to centre of anus	125.7	150.0	101.0	102.5	114.5
8. Notch of the flukes to posterior end of the dorsal fin	—	87.0	57.0	59.0	57.5
9. Notch of the flukes to centre of anus	53.3	61.5	44.0	41.0	46.0
10. Length of the fluke on the outer curvature	27.9	31.0	23.5	18.0	27.0
11. Length of the fluke on the inner curvature	22.8	26.0	18.0	17.0	20.0
12. Distance between the extremities of flukes	40.6	47.0	32.0	26.0	37.0
13. Width at insertion of fluke	10.1	16.5	—	9.0	16.5
14. Length of dorsal fin base	24.1	28.0	20.5	18.0	28.0
15. Vertical height of dorsal fin	20.3	26.0	15.0	10.1	13.5
16. Length of flipper from anterior insertion to tip	31.7	38.0	26.5	22.0	27.0
17. Length of flipper along the curve of lower border	24.1	28.0	19.5	11.0	20.0
18. Greatest width of flipper	11.4	14.0	10.5	9.0	10.5
19. Depth of body at anal region	53.3	63.0	39.0	44.0	25.0
20. Depth of body at origin of flipper	83.8	95.0	64.0	63.0	26.5
21. Depth of body at the origin of dorsal	100.3	122.0	72.0	72.0	44.0
22. Depth of body in the region of eye	72.3	78.0	55.0	50.5	27.0
23. Tip of the lower jaw to the centre of anus	125.7	151.0	105.5	103.0	111.0
24. Length of upper jaw	23.4	27.5	20.5	23.5	25.5
25. Length of lower jaw	24.1	29.0	20.7	24.0	25.0
26. Diameter of the eye	1.5	1.3	1.0	—	0.7
27. Distance between the genital opening and anus	15.3	9.0	5.0	10.0	6.0
28. Total number of teeth on one side of upper jaw	25	25	17	61	66
29. Total number of teeth on one side of lower jaw	24	24	17	58	60
30. Sex	Male	Female	Female	Male	Female
31. Weight in kg	65.0	130.0	26.5	25.0	46.0

Fig. 3 shows pattern of teeth on the upper and lower jaws. It was a female *T. aduncus* measuring 210.5 cm and weighing 130 kg. The stomach with the food weighed 2.6 kg and after removal of all the food items the stomach alone weighed 2.00 kg. The stomach content of the dolphin included fishes namely *Saurida tumbil*, *Sphyraena* spp., *Ilisha* spp., *Trichiurus* spp., *Polynemus* spp., Anchovies and *Stolephorus* spp., and their total displacement volume measured 1,014 ml.

On 8–12–'81 another young female dolphin was caught in a trawl net near Mandapam which was identified as *T. aduncus*. It measured 143 cm in length and weighed 26.5 kg in weight (Fig. 4). Only 17 numbers of teeth were counted on one side of both the jaws and rest of the teeth were in developing stage embeded in the sockets on the jaws. The stomach was cut open and only yellowish fluid was observed.

On 20–2–'82, a young dolphin was washed ashore just opposite to C.M.F.R.I. jetty. It was 145 cm in length and weighed 25 kg (Fig. 5). It was distinguished from *T. aduncus* by the presence of long jaws with rows of small conical teeth; 61 in upper half jaw and 58 in lower half jaw (Fig. 5). The colour on the dorsal side was grey while the belly was white. It was identified as a male of the common dolphin *Delphinus delphis*.

On 8–12–'82 a young dolphin of 159 cm in total length, weighing 46 kg was accidentally caught in a gill net operated from a non-mechanised boat in between Thonithurai and Krusadai Island near Mandapam. It was tied by a rope on its caudal peduncle and was brought

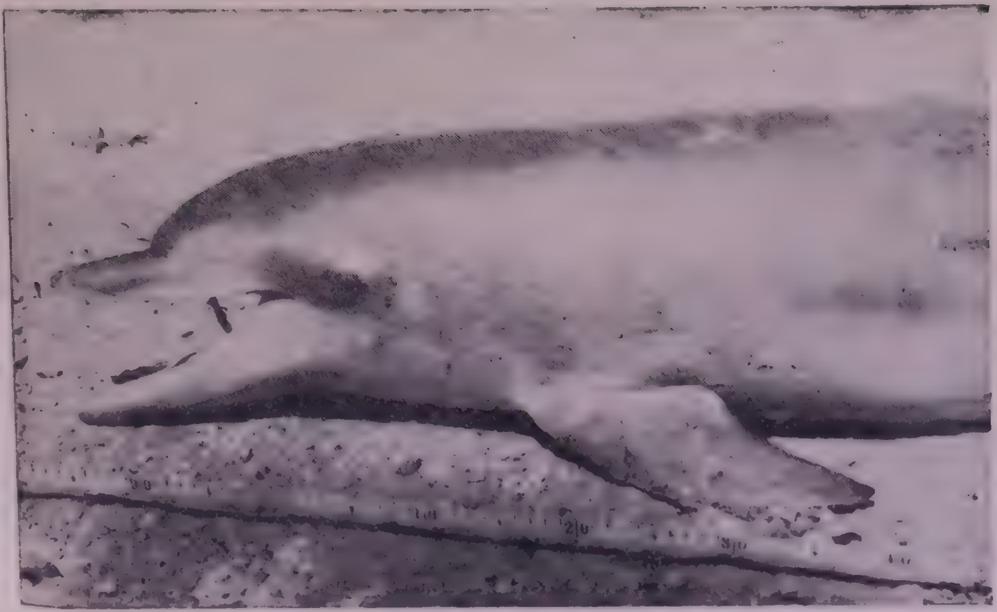

Fig. 1. *Tursiops aduncus* caught on 12-11-'80 in the trawl net from Gulf of Mannar, Mandapam.

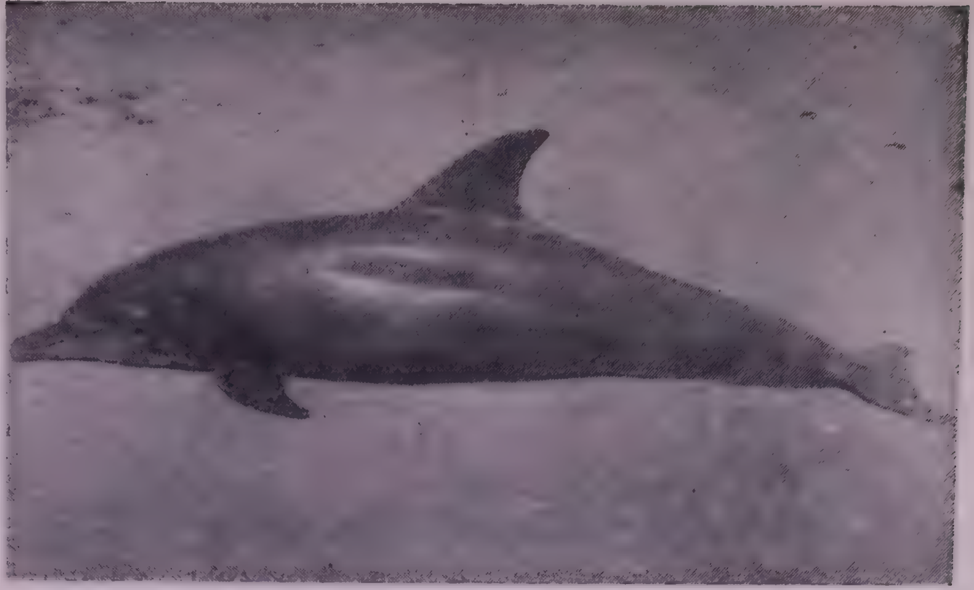

Fig. 2. *T. aduncus* caught on 26-11-'81 in the trawl net from Gulf of Mannar, Mandapam.

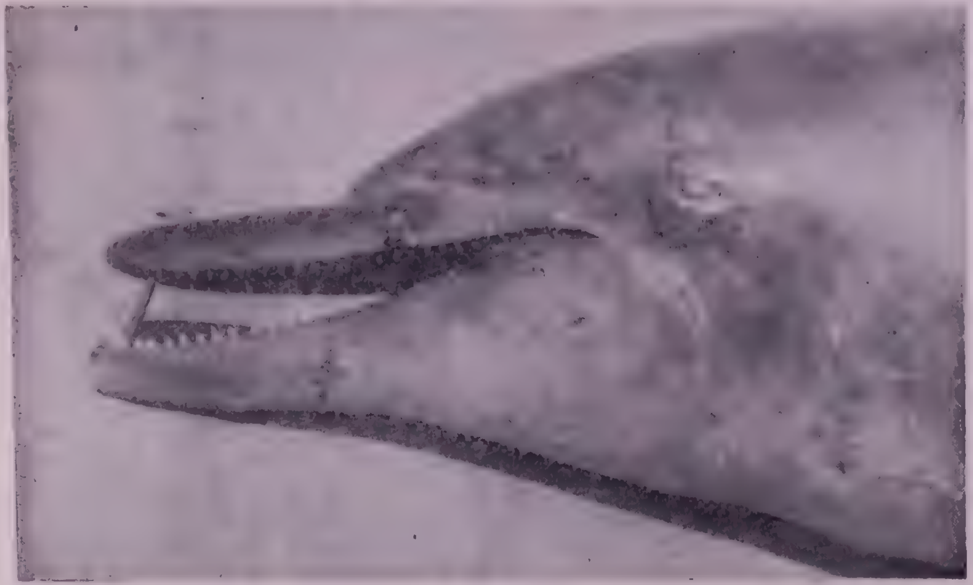

Fig. 3. Head of *T. aduncus* showing 25 numbers of teeth on each side of upper and lower jaws.

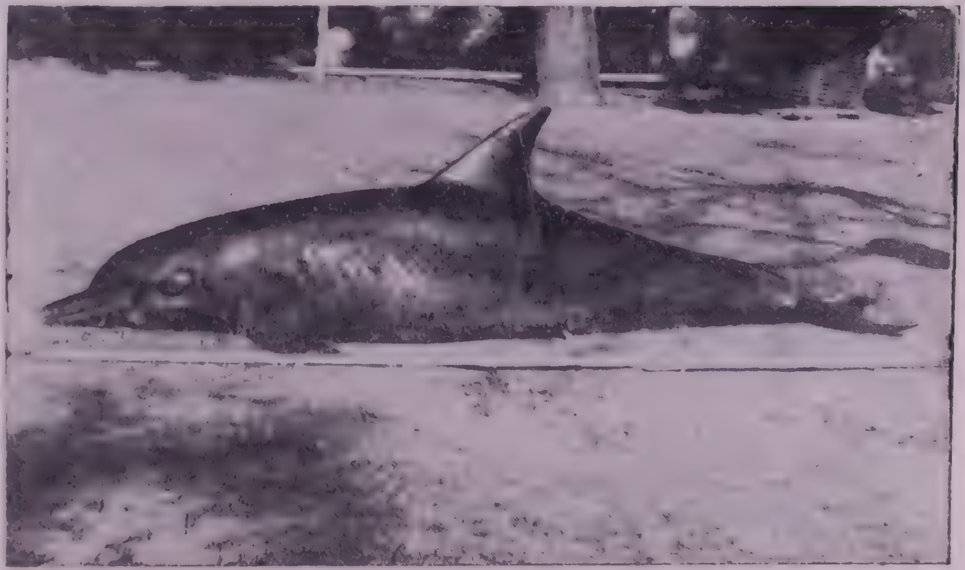

Fig. 4. Young of *T. aduncus* caught on 8-12-'81 in the trawl net from the Gulf of Mannar.

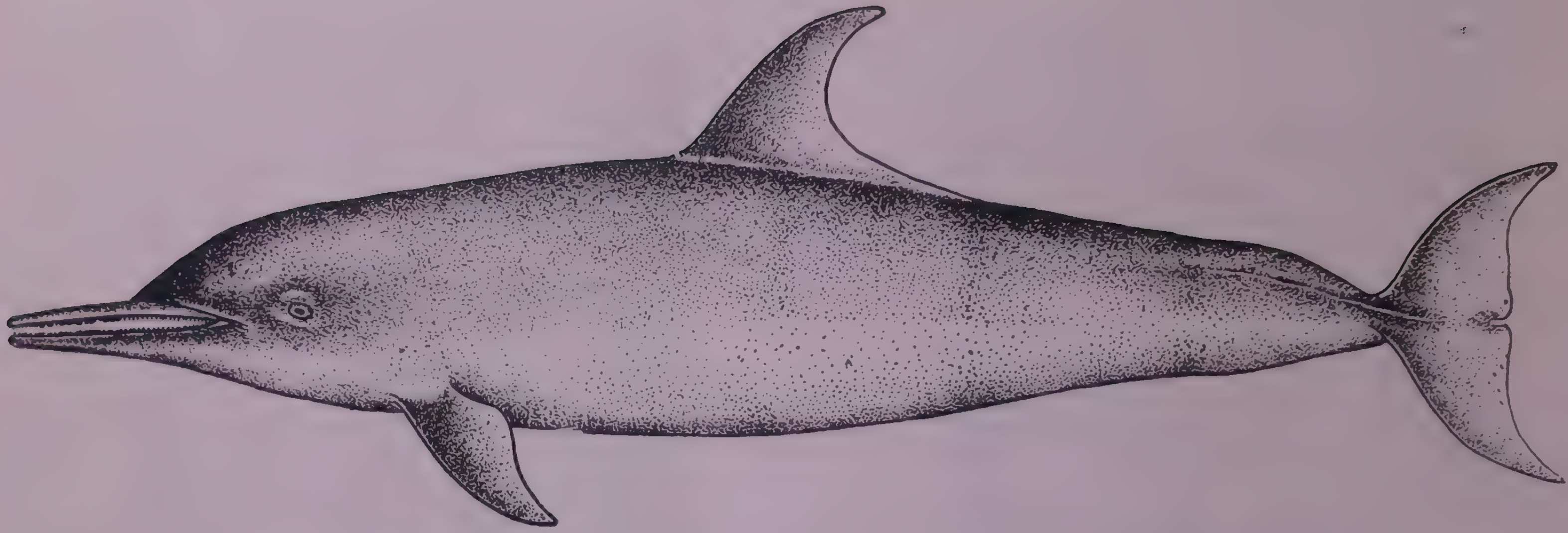

Fig. 5. Drawing of the common dolphin *Delphinus delphis* washed ashore near CMFRI jetty, Mandapam.

to the shore of Thonithurai in live condition. This young dolphin was kept alive near the shore at a depth of one metre for nearly 24 hrs. Attempt to bring it alive to the aquarium did not succeed.

The specimen had elongated jaws bearing small pointed conical teeth. The total number of teeth on one side of the upper jaw was 66, and 60 in the case of lower jaw. It was also identified as the common dolphin *Delphinus delphis.* The analysis of the gut contents showed only yellowish fluid. The weight of the stomach was 450 g and after the removal of the yellowish fluid it weighed 400 g.

REPORT ON A SPERM WHALE *PHYSETER MACROCEPHALUS* LINNAEUS STRANDED ALONG THE GULF OF MANNAR COAST*

The sperm whale *Physeter macrocephalus* although is widely distributed in the world oceans, reports on its stranding along the Indian coasts are few. The following is a report on a sperm whale stranded at Hare Island, Gulf of Mannar.

The whale was stranded around 5–11–'86. However, an immediate visit to the place could not be made. Later, from an on–the–spot enquiry it was understood that the whale was cut open by some local fishermen for ambergris. The discarded carcass was later washed ashore at Seeniappa Dharga, about 3 km away from Hare Island. As it was in a highly decomposed and partly damaged condition the measurements of the skull (Fig. 1) and lower jaw (Fig. 2) alone could be taken which is given below.

1.	Condylobasal length ...	252
2.	Length of rostrum ...	172
3.	Width of rostrum:	
	a. at its base ...	91
	b. at its middle length ...	74
4.	Height of occipital condyle ...	32
5.	Condylar width ...	20
6.	Width of foramen magnum ...	18
7.	Distance from upper edge of foramen magnum to occipital condyle ...	46
8.	Length of lower jaw ...	200
9.	Number of teeth sockets in the lower jaw ...	18

(All measurements in cm)

James and Soundararajan *(J. mar. biol. Ass. India,* **21:** 17-40, 1980) have given the skull length of a 810 cm long sperm whale as 213 cm. They have also estimated the length of another sperm whale to be 1,740 cm whose

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Reported by M. Sivadas, S. Krishna Pillai and M. R. Arputharaj, Regional Centre of CMFRI, Mandapam Camp.

skull had a length of 445 cm. Following them, based on the skull length, the total length of the whale reported now has been estimated to measure between 950 and 1,000 cm.

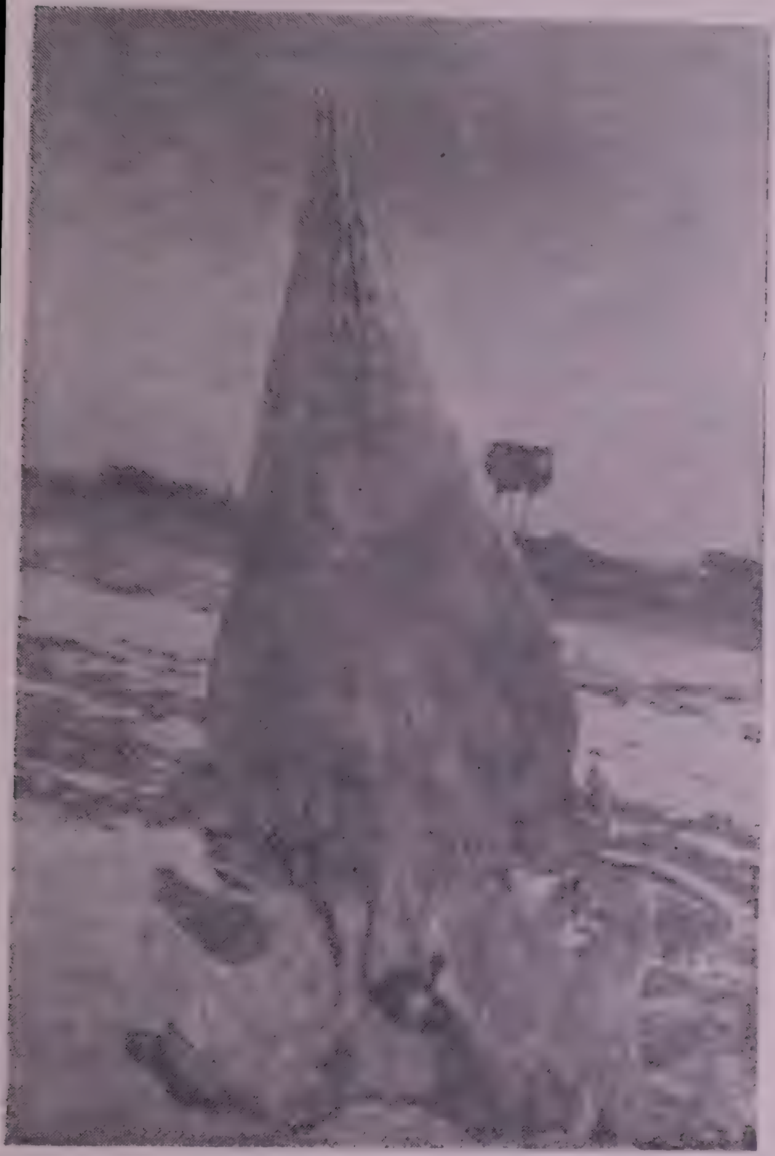

Fig. 1. Ventral view of the skull.

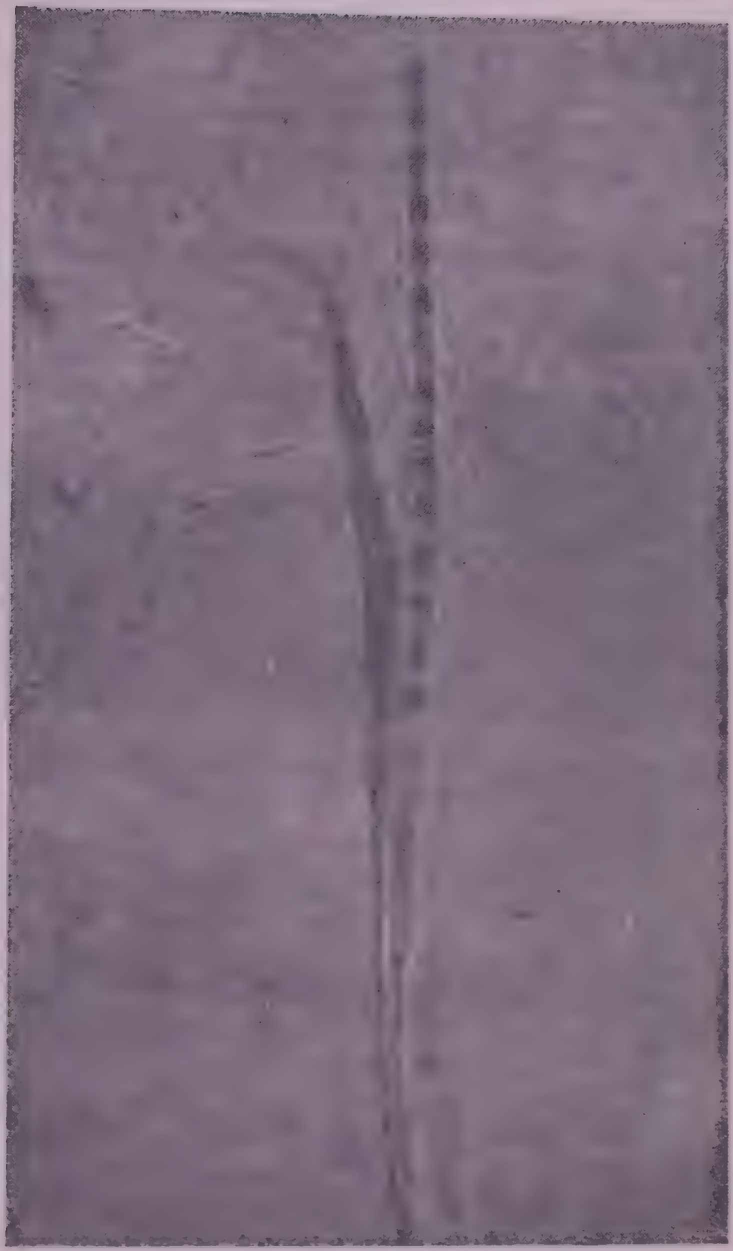

Fig. 2. Lower jaw showing teeth sockets.

* * *

ON A BLUE WHALE *BALAENOPTERA MUSCULUS* STRANDED AT CHAPPA BEACH, NARAKKAL, COCHIN, SOUTHWEST COAST OF INDIA*

The news about the stranding of a whale at Chappa beach, Narakkal was received on 2–9–1985 and an immediate visit to the landing centre was made for further observations and studies. Local enquiries revealed that the carcass was noticed by the fishermen on 31–9–1985 itself. The whale, which was a male was in an advanced state of decomposition. The abdomen was split open and the entire visceral organs were protruding out. The lower jaw was found missing. The blubber over the body was cut and removed by local people and fishermen, as it is believed that the fat in the blubber is a good cure for asthma and other bronchial diseases. The characteristic whale bone was found missing.

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*Prepared by K.V. Somasekharan Nair and A.A. Jayaprakash, Central Marine Fisheries Research Institute, Cochin.

The specimen was identified as a rorqual belonging to the genus *Balaenoptera*. The body was long and slender with a short and flat head. The presence of deep ventral grooves in the skin of the throat and chest extending upto the umbilicus and the ratio of the flipper length to the total length of the species (1:7.7) indicated that the whale could be *Balaenoptera musculus* (Linnaeus). The morphometric measurements of the whale taken are given in Table 1.

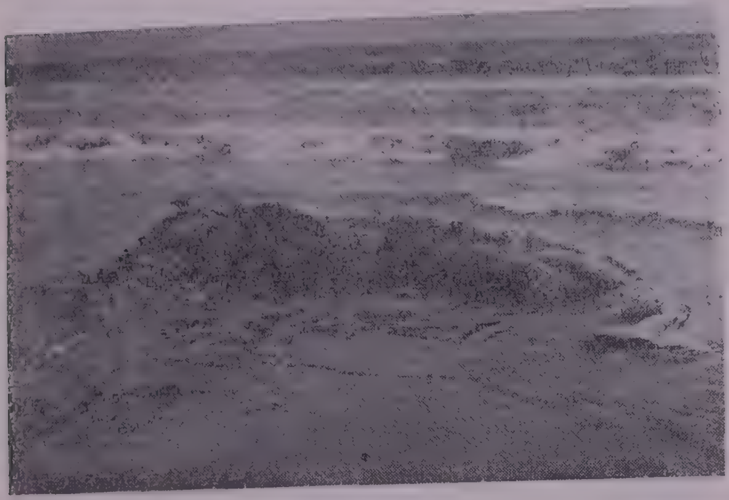

Fig. 1. Dorso-lateral view of the Blue whale *Balaenoptera musculus* (Linnaeus) stranded at Narakkal, Cochin.

Table 1. *Measurements of the Blue whale* Balaenoptera musculus *stranded at Narakkal, Cochin*

Body parts measured	Length (cm)
Total length (snout to caudal fluke)	1,030
Tip of snout to centre of eye	201
Tip of upper jaw to anterior insertion of flipper	175
Tip of upper jaw to origin of dorsal fin	518
Distance between centre of eye and cleft of mouth	61
Length of flipper	133
Distance between extremities of caudal flukes	138
Length of upper jaw	170
Body diameter at the anterior side of the flipper	498
Anterio-posterior length of eye slit	15
Dorso-ventral diameter of eye	7
Approximate weight	6 tonnes

LIME REQUIREMENT OF POND SOILS FOR AQUACULTURE AROUND COCHIN BACKWATERS*

The use of lime in pond fish culture has been advocated by fish culturists over a large part of the world. It is frequently applied to improve the water quality, and several workers have described the favourable effects of liming and stressed its use for increased fish production. Liming increases the pH of bottom mud and thereby increases the availability of phosphorous added as fertilizer. The waters may also be cleared of humic stains of vegetative origin which restrict light penetration. The net effects of changes in water quality following liming is the increase in phytoplankton productivity which in turn, leads to increased fish production.

The application of lime to improve the fertility as well as production is already being practiced by traditional farmers and aquaculturists in the culture systems bordering the Cochin Backwaters and the Vembanad Lake. However, this is done without any scientific estimation of the actual requirement and hence the desired results are not always obtained.

In the present investigation soil samples were collected from different seasonal and perennial prawn culture fields during the premonsoon and monsoon seasons (Fig. 1). The samples were estimated for their lime requirement during both the seasons.

No comprehensive procedure for determining the liming rate was available till recent times. According to Boyd (*Alabama Univ. Bull.*, 459, 1974) the lime, requirement is the amount of liming material needed to neutralize the acidity of bottom muds and increase the total hardness and total alkalinity to at least 20 mg/1. Therefore liming is indicated if either the total hardness or total alkalinity of the pond waters is below 20 mg/1.

The estimation of lime requirement for fish ponds is usually based on exchange acidity. However, in some tropical areas like India, Philippines *etc*. the soil in the brackishwater regions is prevalent with acid sulphate. In order to estimate the lime requirement correctly in such type of soils, the potential acidity is also to be analysed in addition to the exchange acidity. The

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*Prepared by Joseph Gilbert (Senior Research Fellow) and V. K. Pillai, Central Marine Fisheries Research Institute, Cochin.

Table 1. *Total lime requirement based on exchange and potential acidity*

Station No.	Pre monsoon			Monsoon		
	Exchange acidity	Potential acidity	Total* (tons/ha)	Exchange acidity	Potential acidity	Total* (tons/ha)
1	2	3	4	5	6	7
1.	0.448	54.24	54.73	1.120	31.02	32.14
2.	1.512	very high	very high	0.784	55.30	56.08
3.	0.896	95.73	96.62	0.560	29.77	30.33
4.	0.280	74.45	74.73	0.056	34.03	34.08
5.	0.224	53.18	53.40	0.056	33.18	33.23
6.	1.400	52.12	53.52	2.016	44.67	46.68
7.	5.040	57.43	62.47	1.904	51.05	52.95
8.	3.752	55.31	59.06	2.072	55.30	57.37
9.	1.344	77.64	78.98	3.528	72.32	75.85
10.	1.008	75.51	76.52	3.360	68.06	71.42
11.	1.456	75.51	76.96	0.840	29.77	30.61
12.	0.784	76.58	77.36	0.560	31.54	32.10
13.	1.568	76.58	78.15	2.128	76.69	78.82
14.	1.400	75.51	76.91	2.016	77.78	79.79
15.	0.560	73.40	73.96	1.400	55.30	56.70
16.	0.728	74.50	75.23	1.232	51.05	52.28
17.	3.024	44.67	47.69	1.288	85.06	86.34
18.	2.800	52.12	54.92	1.680	87.25	88.93
19.	3.248	51.05	54.29	1.568	88.11	89.67
20.	3.192	55.31	58.50	1.904	89.32	91.22
21.	0.168	12.76	12.93	**	18.29	18.29
22.	0.168	10.63	10.79	**	17.43	17.43
23.	0.112	11.70	11.81	**	17.86	17.86
24.	0.784	65.94	66.72	**	46.79	46.79
25.	0.616	63.82	64.43	**	44.67	44.67
26.	0.840	64.68	65.52	**	47.65	47.65
27.	1.008	63.82	64.83	0.056	51.05	51.10
28.	1.400	74.45	75.85	0.672	42.54	43.21
29.	1.232	75.58	77.81	0.504	44.67	45.17
30.	1.120	74.45	75.57	0.560	38.28	38.84
31.	0.840	85.09	85.93	0.504	63.82	64 32
32.	0.728	84.03	84.76	0.448	64.94	65.42
33.	1.680	82.96	84.64	0.560	59.56	60.12
34.	2.856	21.27	24.12	**	19.14	19.14
35.	2.800	29.78	32.58	**	17.01	17.01
36.	2.912	26.59	29.50	**	21.27	21.27
37.	3.308	42.54	45.85	0.840	42.54	43.38
38.	3.640	44.67	48.31	1.624	43.06	44.68
39.	2.968	43.60	46.57	0.224	34.03	34.25
40.	3.304	69.10	72.40	0.840	80.83	81.67
41.	3.920	63.82	67.74	2.016	85.09	87.10
42.	3.192	59.45	62.64	1.400	89.34	90.74
43.	5.040	85.09	90.13	1.120	61.68	62.72
44.	5.600	86.15	91.75	0.840	59.56	60.40
45.	5.488	80.23	85.72	0.560	65.03	65.59

Table 1. (Contd.)

1	2	3	4	5	6	7
46.	3.864	42.54	46.40	0.840	59.56	60.40
47.	3.920	52.12	56.04	1.120	61.62	62.74
48.	2.576	42.54	45.11	1.008	64.03	65.03
49.	3.304	10.63	13.93	**	12.76	12.76
50.	3.752	12.76	16.51	**	14.88	14.88

* The lime requirement is calculated by considering the weight of soil of 15 cm depth per hectare.

** The stations showed no lime requirement by the exchange acidity method.

total lime requirement is calculated by adding both the values together. The lime requirement based on exchange acidity was estimated in the present study following the method developed by Pillai and Boyd (*Aquaculture*, 46: 157–162, 1985) and the potential acidity following the method by Boyd (*Water quality management for pond fish culture*, Elsevier, 1982).

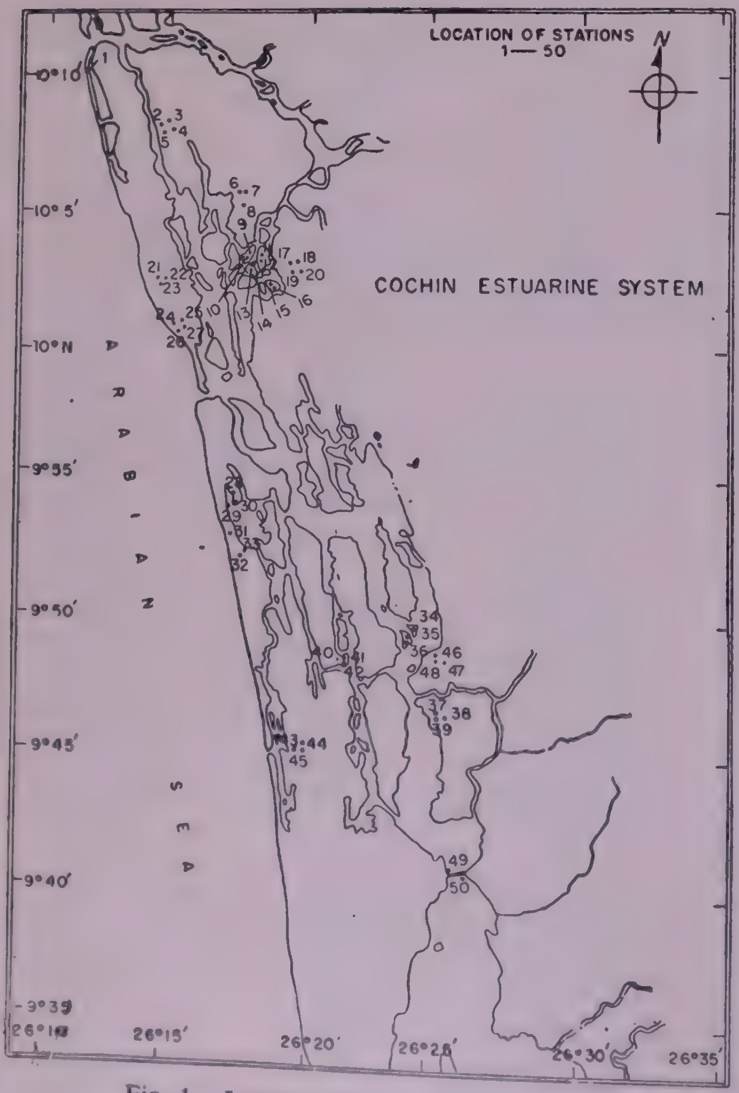

Fig. 1. Location of sampling stations.

Table 1 gives the lime requirement for the soils in the different stations based on exchange acidity as well as potential acidity and also the total lime requirement. By the exchange acidity method, during premonsoon, it varied from 0.112 to 5.6 tonnes of lime per ha in Narakkal (St. 23) and Thuravoor (St. 33) respectively. However, during monsoon, the requirement of lime was found to be less with eleven stations recording nil, and a maximum of 3.528 tonnes of lime/ha being observed in Chenoor (St. 9).

The lime requirement based on the potential acidity showed considerable variations in different stations. During the premonsoon period the values ranged from 10.63 tonnes/ha in Narakkal (St. 22) to 95.73 tonnes/ha in St. 3. During monsoon the values were 17.01 tonnes/ha in St. 35 to 89.34 tonnes/ha in St. 42.

The total lime requirement calculated by adding both the exchange acidity and potential acidity values ranged from 10.79 (St. 22) to 96 (St. 3) tonnes/ha during the premonsoon season. During the monsoon the range was from 12.76 to 91.22 tonnes/ha at St. 50 and St. 20 respectively.

From the present study it is evident that some soils around the Cochin estuarine area have acid sulphate problem. The lime requirement is found to be very high in these regions. Generally high liming rates are associated with low pH values. But in the present investigation most of the stations recorded pH values above 6.0 Statistical analysis showed no relationship between pH and the liming rates. This is due to the collection of soil samples submerged in water during both the seasons Though the submerged samples showed high pH values (above 6.0) their potential acidity is high and requires higher liming rate. In such cases the high pH values are misleading. This explains the high potential acidity in soil samples even with normal pH during the present study.

SOME NOTES ON QUEENFISHES AND THEIR FISHERY ALONG THE INDIAN COASTS*

A large variety of fishes popularly called horse mackerels, shads, trevellies, queenfishes, pompanos, runners *etc.* comprise the family Carangidae which includes four well defined subfamilies *viz.*, Caranginae, Scomberoidae, Naucratinae and Trachinotinae. Among them, the subfamily Scomberoidae represented by the genus *Scomberoides (– Chorinemus)* is popularly known as queenfishes.

The queenfishes are distributed widely along the warm coastal waters of eastern Indian Ocean, western Indian Ocean and western central Pacific and are restricted to neritic waters near continental shelf. They form an important constituent in the marine fish landings of India especially along the Tamil Nadu and Andhra Pradesh coasts. However, very little is known about their fishery and biology. An attempt is made here to highlight some of the taxonomic characters for easy field identification and also to review in brief the status of fishery of this group of fishes.

These fishes possess a compressed elongate body and a blunt snout with a depression over eye. Dorsal and anal fin bases are approximately equal in length. Anal fin is with two detached spines, the characteristic of the family Carangidae, with 16–19 soft rays but without anal scutes. Lateral line is slightly wavy anteriorly and straight over most of its length (Fig. 1). The body colour is dusky green above with silvery golden yellow below. Based mainly on the nature of 5–8 blotches over the lateral line and also by the length of maxilla in relation to eye, four distinct species are recorded from Indian waters *viz.*, *Scomberoides commersonianus, S. lysan, S. tala* and *S. tol* as shown in Fig. 2 *(Species identification sheets for fishery purposes, FAO,* 1974).

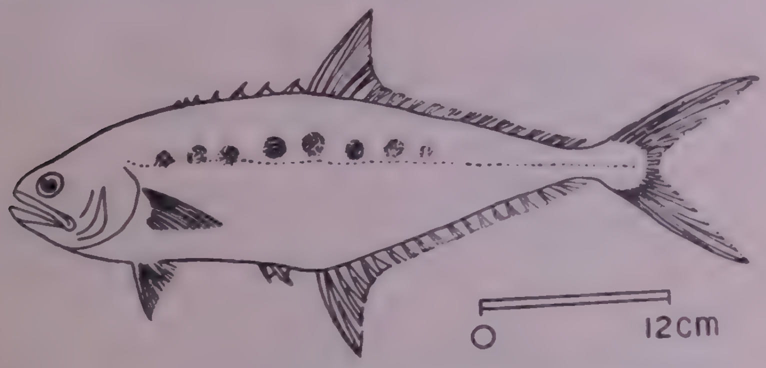

Fig. 1. The dominant species of the queenfish *Scomberoides commersonianus.*

According to a recent study (Circular No. 710, FAO, 1985), during the period 1981–'84, the entire carangid fishes contributed to about 36,000 tonnes and 192,000 tonnes from the eastern Indian Ocean and western Indian Ocean respectively.

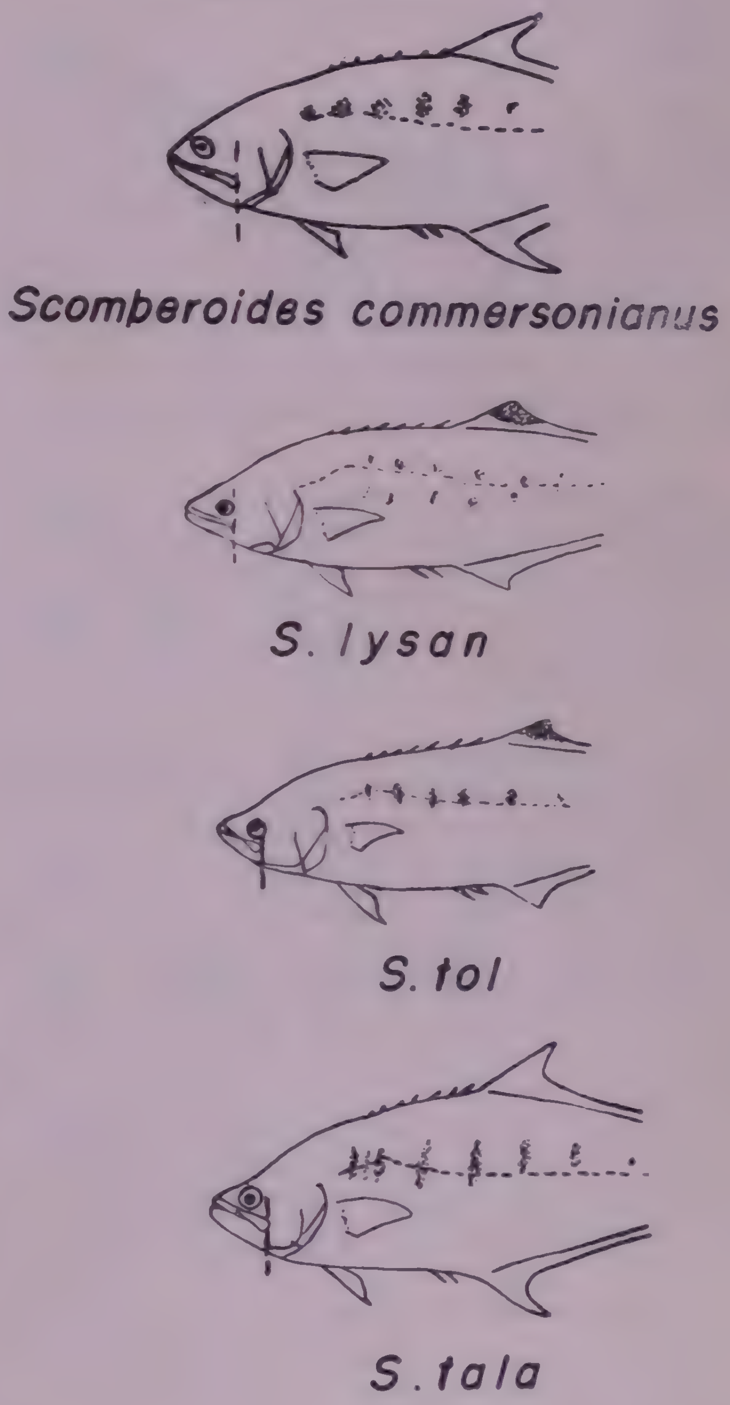

Fig. 2. Systematic characters of four species of queenfishes.

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*Prepared by P. K. Mahadevan Pillai, M. Ayyappan Pillai and A. A. Jayaprakash, C.M.F.R.I., Cochin.

Fig. 3 represents the landings of queenfishes along the Indian coasts during 1971–'84 period. Trends in the landings indicate steady increase from 1978–'79 period to a maximum of 10,005 tonnes landed in 1983, although some minor fluctuations are seen in certain years. Tamil Nadu recorded maximum landings followed by Andhra Pradesh, Gujarat and Maharashtra contributing to 27, 22, 19 and 9 per cent respectively of the total queenfish landings in the country during 1971–'84 period.

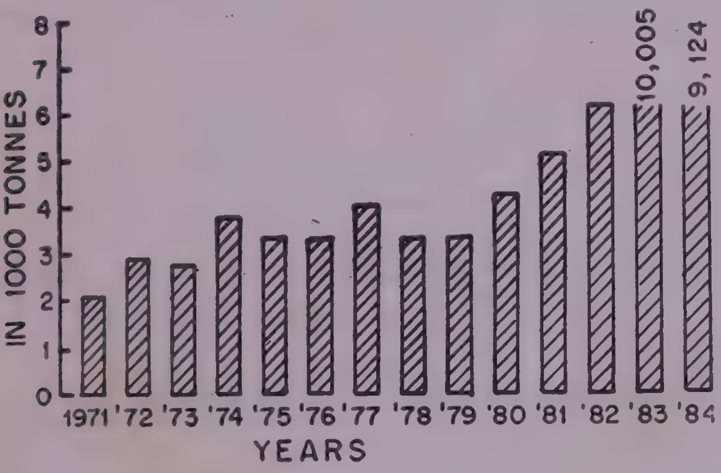


Fig. 3. The landings of queenfishes from Indian waters during 1971–'84.

Queenfishes are landed seasonally along the Kerala coast by the drift gill nets. During 1981–'85 period, a study was made on the trend of landings of these fishes at Cochin Fisheries Harbour. Some observations were also made in 1982 and 1983 on the various size groups contributing to the fishery.

The mechanised drift gill netters, operating off Cochin that land queenfishes, range from 7.62 to 9.14 m in length and are operated generally in the 20–50 m depth range confining to the surface and mid-depth zones (Silas, E.G. 1984, *Mar. Fish. Infor. Serv., T & E Ser.*, **55**: 1-12). Among the queenfishes, *Scomberoides commersonianus* formed the major species that landed at Cochin Fisheries Harbour, the other species being *S. tol.*

Fig. 4 shows the average monthwise estimated landings of queenfishes during the five year period, 1981–'85 at Cochin Fisheries Harbour. Peak landing takes place during June, July, August and October.

The length frequency data on *S. commersonianus* collected during August, September and October of 1982 and '83 are shown in Fig. 5. The total length was measured from the tip of snout to the elongated lobe of caudal fin and the size of fish measured were in the length range of 31 to 90 cm. In 1982 while the fishery comprised size groups ranging from 31-40 cm to 81-90 cm in the month of September the same was between 21–30 cm and 61-70 cm with a gap of size groups between 41–50 and 51–60 cm. In 1983, however, a single size group 71–80 cm predominated the fishery although the size groups in the fishery ranged between 31–40 cm and 81–90 cm.

The price of queenfishes at the Fisheries Harbour in the above three months of 1982 and 1983 was around Rs. 12–14 per fish which fell to Rs. 4-6 during the peak landing. From the monthly landings and price structures collected during the above period, it is estimated that a sum of Rs. 93,962 and Rs. 2,41,876 were realised in 1982 and '83 respectively from this fishery alone.

Apart from the fishery and biological investigations from Rameswaram Island by James *(Indian J. Fish.* **11** A (1): 269-276, 1964) information are lacking on queenfishes from the Indian waters. Adult queen fishes feed mainly on larger fishes whereas young ones subsist on smaller fishes and crustaceans. The reason for the landings of immature and juvenile queenfishes is attributed mainly to the selectivity of gear.

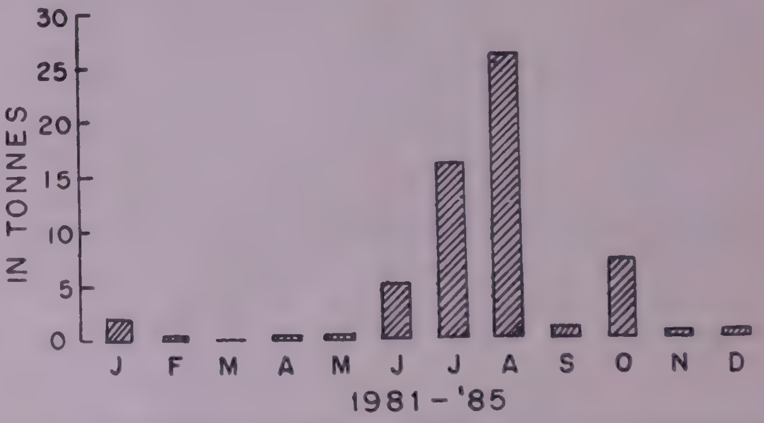


Fig. 4. Estimated average monthly landings of S. commersonianus from Cochin Fisheries Harbour during 1981–'85.

The fecundity studies on queenfishes, mainly *S. lysan* (James, 1964) indicated that the total number of eggs in mature ovary varied between 8 and 35 lakhs. These fishes spawn at least twice during the spawning season (April to August) along the Palk Bay and Gulf of Mannar coasts.

From the distribution and relative abundance of larval and early juvenile stages measuring 3 mm to 25 mm of *Chorinemus sanctipetri,* it is estimated that this species spawns during March–April period along the southwest coast of India (Premalatha, 1977, *Proc.*

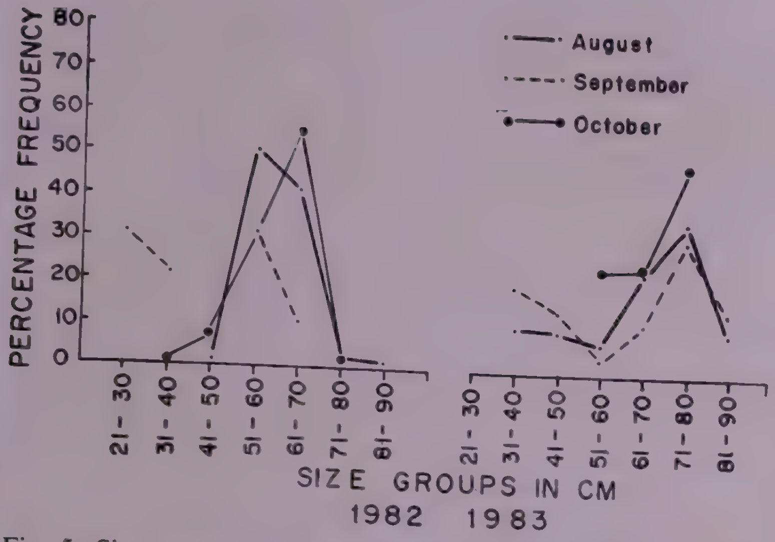
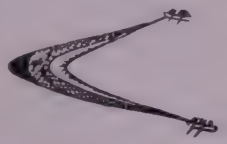


Fig. 5. Size groups of *S. commersonianus* landed at Cochin Fisheries Harbour during August, September and October of 1982 and 1983.

Symposium on Warmwater Zooplankton: 450–459). Due to lack of descriptions regarding the specific identity of early juvenile stages in other species of queenfishes, the above study assigning larval and juvenile stages to *C. sanctipetri* appears to be not valid. It is more likely that the species refered to is *S. commersonianus* the predominant species along the Kerala coast. Moreover, from the indicated spawning period *i.e.* March–April it appears that the queenfishes have a restricted spawning period. But the availability of young ones of queenfishes for a longer period in trawlers and drift gill netters at the Cochin Fisheries Harbour does not support this view.



HEAVY LANDINGS OF PRAWN (*METAPENAEUS DOBSONI*) BY PURSE-SEINERS AT PANAJI—GOA*

In Goa the purse-seiners are operated mostly in Panaji, Vasco-da-Gama, Balina, Colva, Cotbona, Betul and Talpona centres. Out of these Panaji and Cotbona are the major purse-seine landing centres, where more than 30 seiners are in operation. The area of fishing is northwest off Panaji–Calangute belt in 20–25 m depth zone.

On 19th September, 1984 during routine observations for the biological studies of pelagic fishes caught by purse-seines at Panaji, unusually heavy catches of penaeid prawns exclusively of *Metapenaeus dobsoni* were found landed by purse-seiners. The trend continued till 24th September, 1984 (Table IA). On an average of 600–700 kg of prawns were landed by each boat/trip during six days of fishing.

In the subsequent year also instances of heavy landings of penaeid prawns were observed for purse-seine on three occasions. (Table IB).

TABLE 1A

Date	No. of purse seines operated	Penaeid prawns (kg)	CPUE	Estimated value (Rs.)
19-9-'84	18	8,535.0	474.17	76,815.00
20-9-'84	22	12,100.0	550.00	1,08.900.00
21-9-'84	22	14,879.9	576.36	1,33,919.10
22-9-'84	24	21,360.0	890.00	1,92,240.00
23-9-'84	22	13,948.0	634.00	1,25,532.00
24-9-'84	18	3,970.0	220.00	35,730.00
6 days	126	74,792.9	593.59	6,73,136.10

TABLE IB

16- 5-'85	1	1.400.0	—	12,600.00
23- 9-'85	1	320.0	—	2,800.00
1-11-'85	1	600.0	—	5,400.00
3 days	3	2,320.0	—	20,880.00

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*Reported by G. M. Kulkarni, T. S. Balasubramanian and S. Kemparaju, Field Centre of CMFRI, Goa.

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Abbreviation – *Mar. Fish. Infor. Serv., T & E Ser.,* No. **72**: 1987

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Front cover photo:

Tunas being smoked over an iron grill; a step in the preparation of 'masmin'.

Back cover photo:

Live-bait fishes to be used in the pole and line fishing for tunas being fished from the coral lagoon in Bangaram, Lakshadweep. Also note the live-bait tank for keeping the fishes alive.

IMPRESSIONS OF A RECENT VISIT TO LAKSHADWEEP FROM THE FISHERIES AND MARINE BIOLOGICAL PERSPECTIVES

P. S. B. R. James, P. P. Pillai and A. A. Jayaprakash

Central Marine Fisheries Research Institute, Cochin

In the recent times, the Lakshadweep has been in the limelight owing to the special considerations shown by the Government of India towards its alround development and the welfare of the people. The Prime Minister during his recent visit to the Lakshadweep has evaluated the overall conditions there, and while taking manifold steps for improving the socio-economic aspects of the islands and the people, has stressed the need for effective involvement of all the agencies concerned with the development of these remote islands. Occupying a pivotal position in the economy of the islands, the marine fisheries has to play a key role in maintaining and upgrading the standard of the life in the islands. In this context CMFRI had already contributed to the management of marine fisheries resources and steps are now being taken to expand its research activities in particular fields.

In order to make an on-the-spot study of the pole and line fishery for skipjack, live-bait fishes, coral reef ecosystem and the associated flora and fauna and other ancillary marine resources in the Lakshadweep, the senior author accompanied by the other two scientists made a visit to four of the islands, namely Minicoy, Kavaratti, Agatti and Bangaram from 20 to 28 February, 1987.

During the visit it was found that considerable damage had taken place to the coral reefs around Minicoy Island and this could be one of the reasons for the disappearance of the live-bait fishes in the region. To remedy the situation, one method would be to provide small artificial reefs in the Minicoy lagoon for attracting different species of live-bait fishes which are known to exist in the lagoon and outside. Similar attempts made in Hawaii have proved very successful.

For immediate relief to the fishermen, urgent research is needed to study the live-baits in confinement for understanding the behaviour of each species, their capability to survive and the densities at which they could be maintained. The results emerging out of such studies would help fishermen to adopt new methods of storing live-bait fishes for use when the same cannot be collected readily from the sea.

There appears to be great scope for exploiting the wide variety of ornamental fishes such as *Heniochus acuminatus, Dascyllus aruanus, Rhinecanthus* sp., *Holocentrus* spp., *Chaetodon auriga, Acanthurus* sp. *etc*, available in different islands of Lakshadweep. While it would be difficult to assess the stocks of these fishes, from information available so far, it appears that there was no decline in the stock of these fishes. For proper utilisation of these fishes for ornamental purposes in aquaria, it is necessary to conduct experiments on the maintenance of these fishes under artificial conditions. Some trials of transport onboard vessel and by air as well as their maintenance with and without the coral associates need to be done to develop domestic as well as export market. Trials have already been initiated at Minicoy in this direction in respect of the species like *Chromis caeruleus, Dascyllus aruanus, Archamia fucata* and *Caesio caerulaureus*.

The other fishes observed during the visit and also during the inter-island travel include flying fishes and belonids, which were found gliding on the surface. Muraenid eels were observed in coral reef areas. Large sized carangids were noticed in the deeper waters and can be caught in troll lines.

While the coral ecosystem at Minicoy has sustained some damages and seems to have considerably changed from the situation prevailed decades before, the same ecosystem around Agatti and Bangaram does not appear to have been affected to that extent by human activity. In view of this, it is advisable that at least in islands where the coral reefs are not damaged, measures have to be taken to properly preserve the environment so that the nature's balance with reference to the flora and fauna can be maintained for deriving maximum benefits. The coral reefs around Agatti and Bangaram islands show luxuriant growth and provide good natural habitat for different live-bait fishes. Other associated fauna and flora are also abundant. Fishermen were observed to go specially in search of two species of sprats *(Spratelloides delicatulus* and *S. japonicus)* in the extensive lagoon of the Bangaram Island. This lagoon also provides a congenial habitat for a variety of molluscs, corals, ornamental fishes and edible varieties of fishes like the lutianids *(Lutianus gibbus)*, lethrinids *(Lethrinus xanthochelus)* and goatfishes *(Mulloides vanicolensis)*. These fishes could easily be caught by the hook and

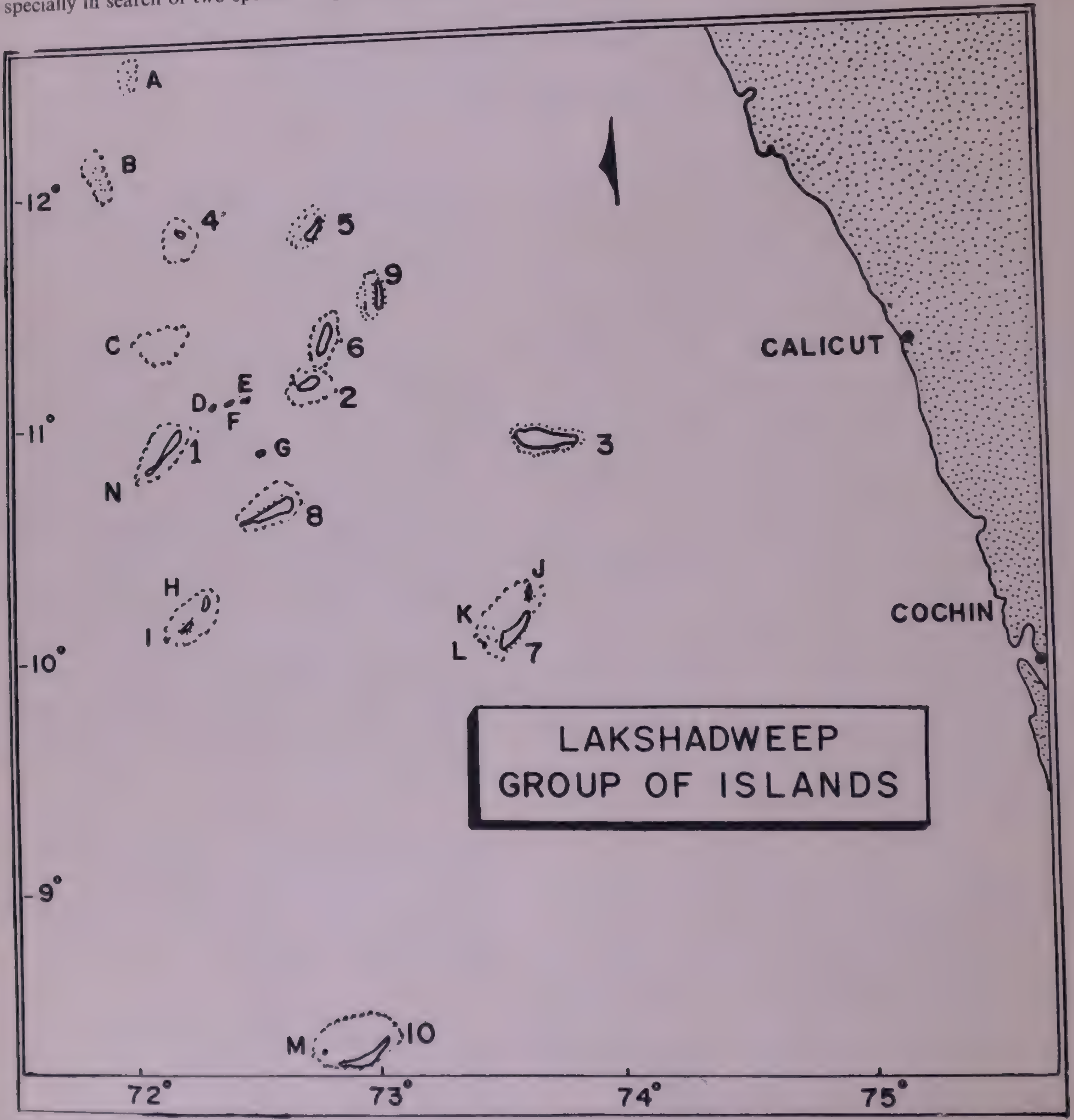

Fig. 1. Inhabited islands: 1. Agatti, 2. Amini, 3. Androth, 4. Bitra, 5. Chetlat, 6. Kadmat, 7. Kalpeni, 8. avaratti, 9. Kiltan and 10. Minicoy. Uninhabited islands: A. Cherbaniani or Baliapaniyam Reef, B. Byramgore or Chereapani Reef, (C) Peremul Par, (D) Bangaram, (E) Parali 1-3, (F) Tinnakara, (G) Pitti (Bird Island), (H) Suheli Valiyakara, (I) Suheli Cheriyakara (Seasonally inhabited), (J) Cheriyam, (K) Pitti, (L) Tilakkam 1-3, (M) Wiringli and (N) Kalpitti.

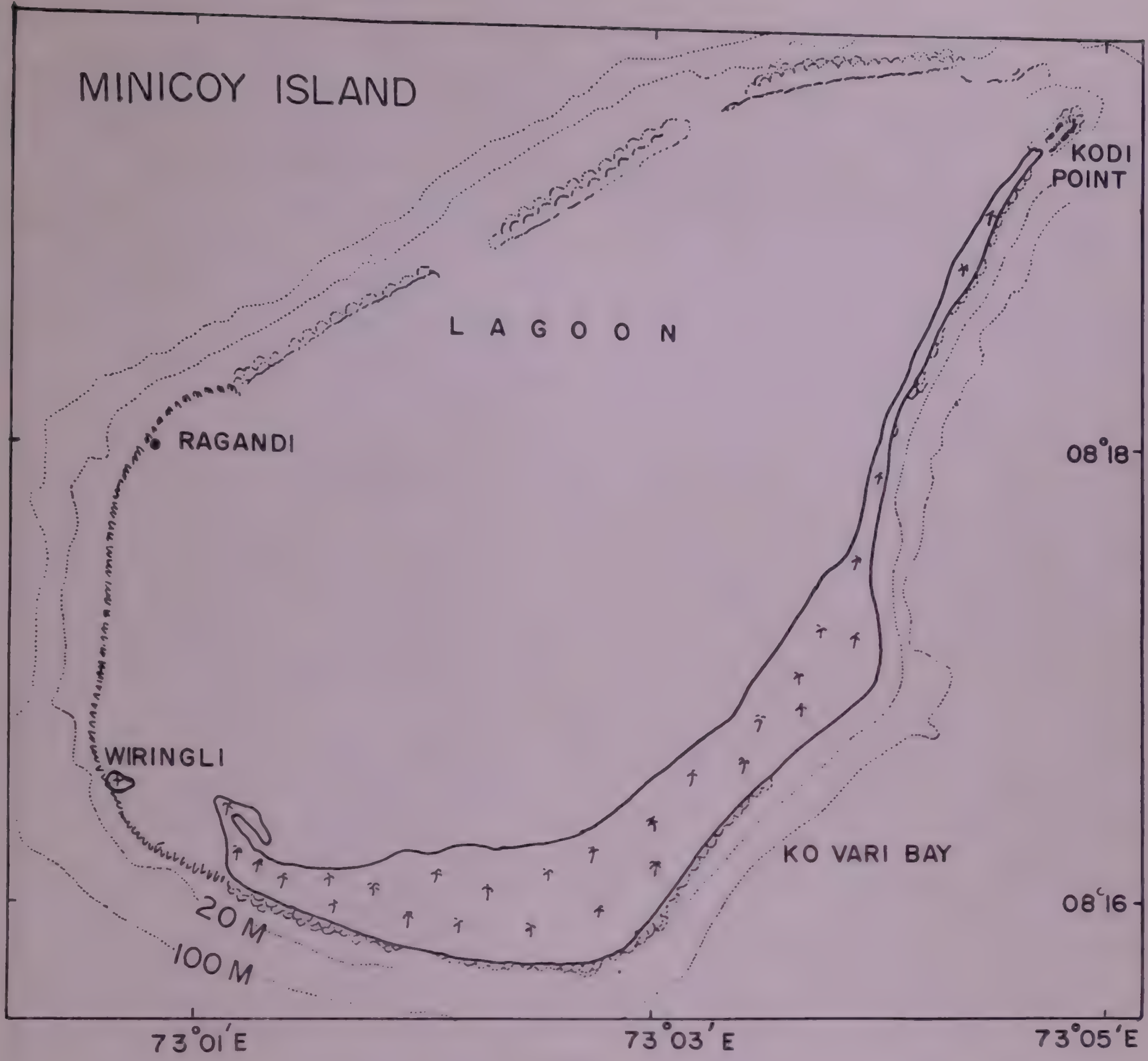

Fig. 2. Minicoy Island

line using sipunculids *(Sipunculus indicus)*, available in the sandy stretches of the lagoon, as bait. The other fishes that could be netted easily at times of high tide include *Gerres acinaces, G. filamentosus, Caranx melampygus, Trachinotus bailloni* and *Bothus pantherinus*.

Although a luxuriant growth of seaweeds is expected in association with coral reefs, high abundance of seaweeds has not been noticed in any of the islands visited. A few seaweeds which were collected include the green alga *Halimeda gracilis*, the brown alga *Turbinaria* sp., the red alga *Gracilaria crassa, Hypnea musciformis, Laurencia papillosa, Acanthophora spicifera* and the calcareous alga *Lithophyllum*. The lagoon areas of the islands indicated sea grass beds dominated by the species, *Thalassia hemprichii*.

The echinoderms collected and observed were *Holothuria (Microthele) nobilis* (very good for *Beche-de-mer*), *Bohadeschia argus* (can be tried for *Beche-de-mer*), *Stichopus chloronotus* (no commercial value), *Culcita novaeguineae* and *Echinometra mathaei*.

Among the molluscs, the giant clam *Tridacna* sp. (live as well as shells of dead ones) was noticed. The mantle edges of different individuals were observed to be bright orange and brown. *Trochus radiatus*, *Lambis* spp., *Conus* spp., *Arabica arabica* and *Cassis cornula* were also available.

Among corals *Acropora* spp. dominated. *Poritus* sp., *Cavilastrea* sp., *Coeloseris* sp. and *Platygura* sp. were noted.

On the beaches of Bangaram Island young and adult ghost crabs *(Ocypoda ceratophthalmus)* were found to be active especially at night in the intertidal zone. The holes are made very characteristically by the crab by depositing the excavated sand in heaps about half a metre away from the hole.

As well known, the species of tuna which mainly supports the fishery in the Lakshadweep is the skipjack

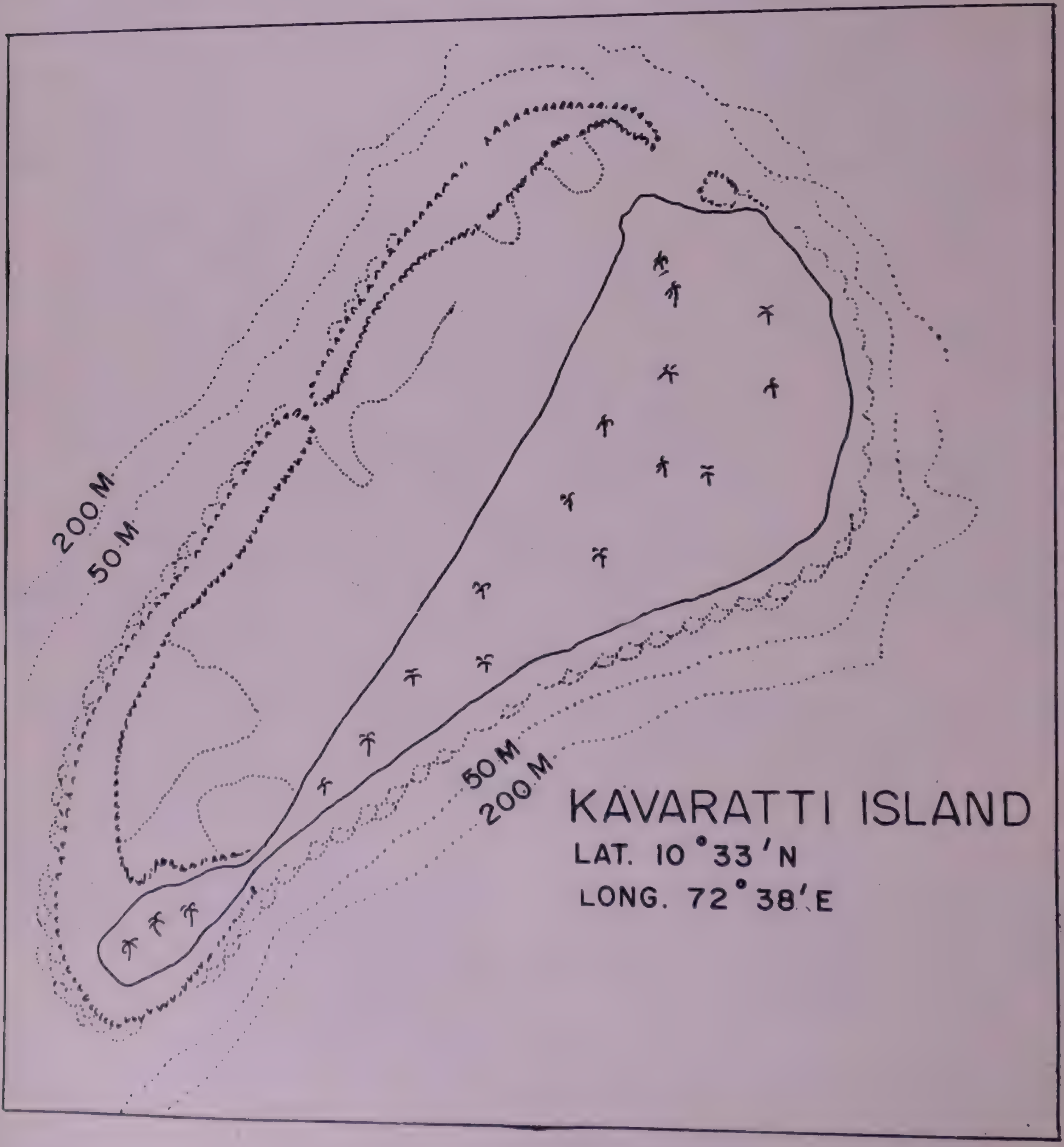

Fig. 3. Kavaratti Island

on which the entire fishing activity and 'masmin' trade depends. The average catch of tunas (1981–'85) was 3,265 tonnes and the catch during 1985 amounted to 3,775 tonnes. The whole economy of the islands revolves around this fish. Large schools of skipjack occur in the region during the season especially from September to May. One school which was specifically observed and on which pole and line fishing took place, occupied a circular area, the radius of which could easily be about 200 metres. The school was quite active, splashing the water at the surface and remained in position for about two hours when large numbers of fish were caught. However, when compared to the vastness of the school and the possible high number of fish within the school, the number of fish actually caught did not appear to be significant. It was apparent, inspite of about 20 boats fishing on the school, that the tunas were not scared by the sounds or other disturbances but continued to swim in the same area. The skipjack in the school ranged in size between 58 and 62 cm. Examination of the specimens landed at Agatti indicated dominance of males over females. No distinct flocks of birds were noticed associated with the tuna schools. A group of porpoises were also noticed at sea between Agatti and Bangaram islands.

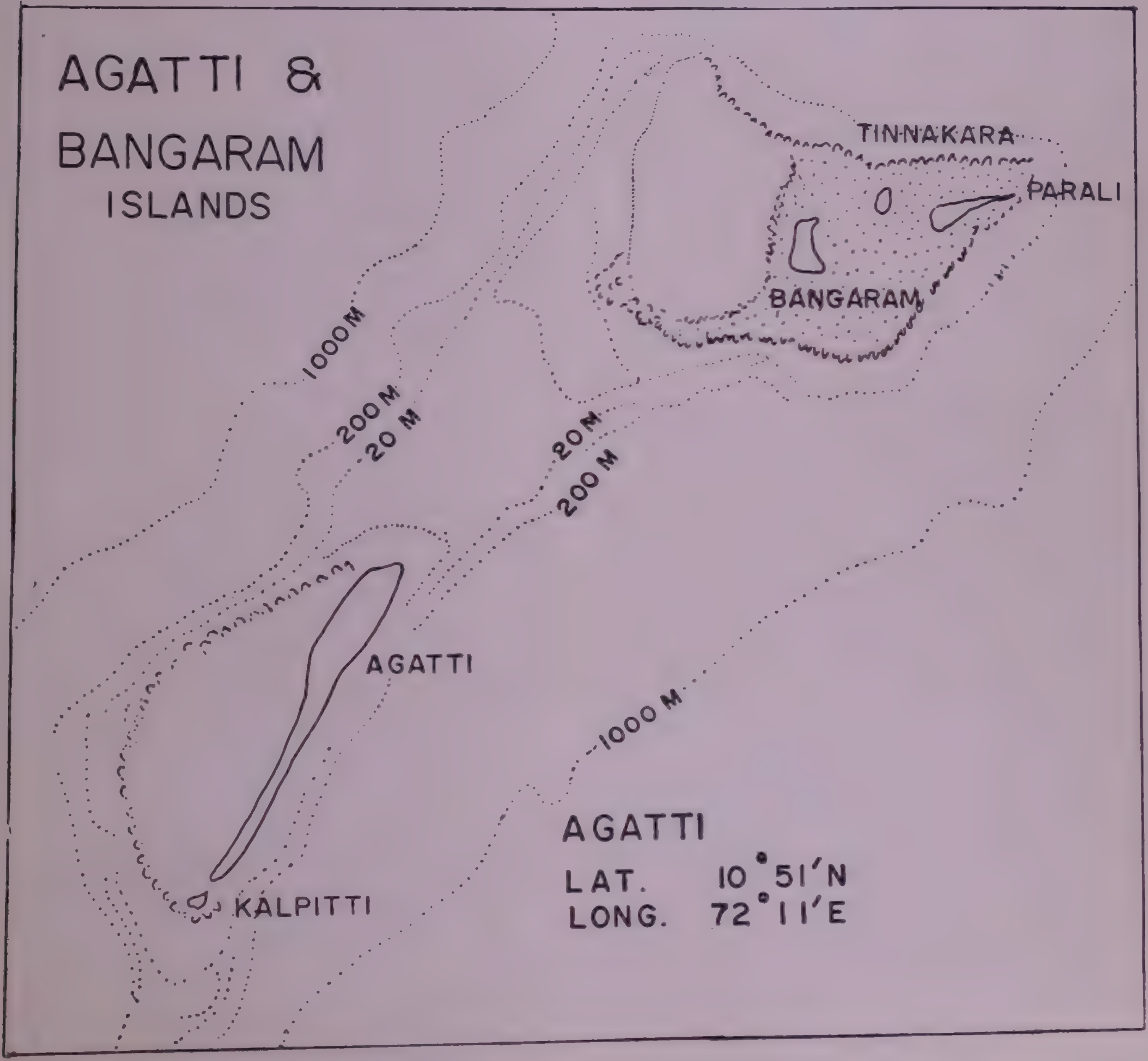

Fig. 4. Agatti and Bangaram islands

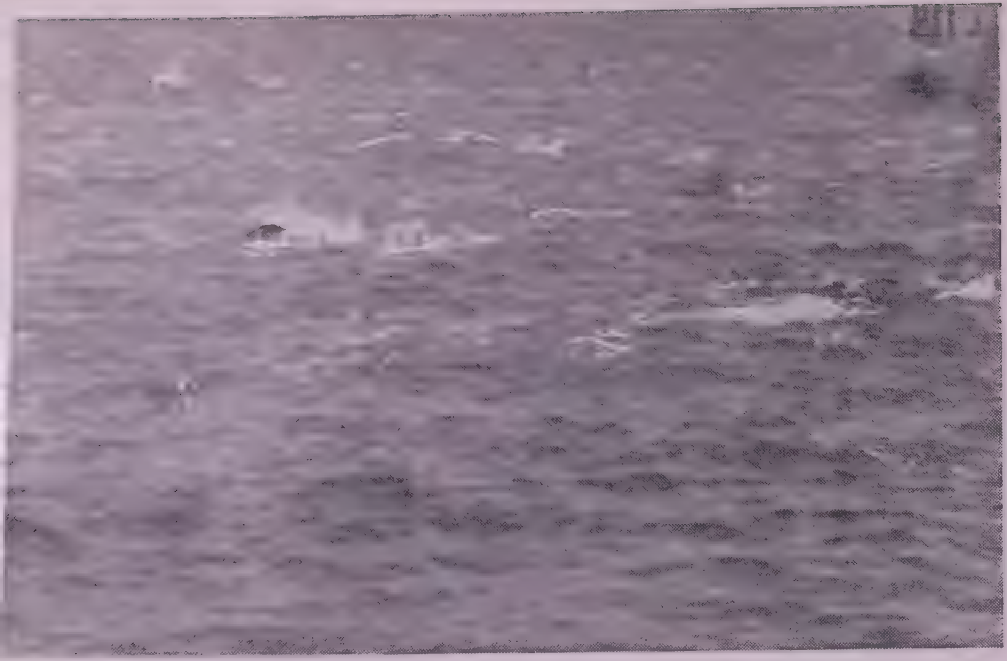

Fig. 5. Characteristic water movement caused by the 'boiling' nature of the skipjack tuna schools off Agatti Island.

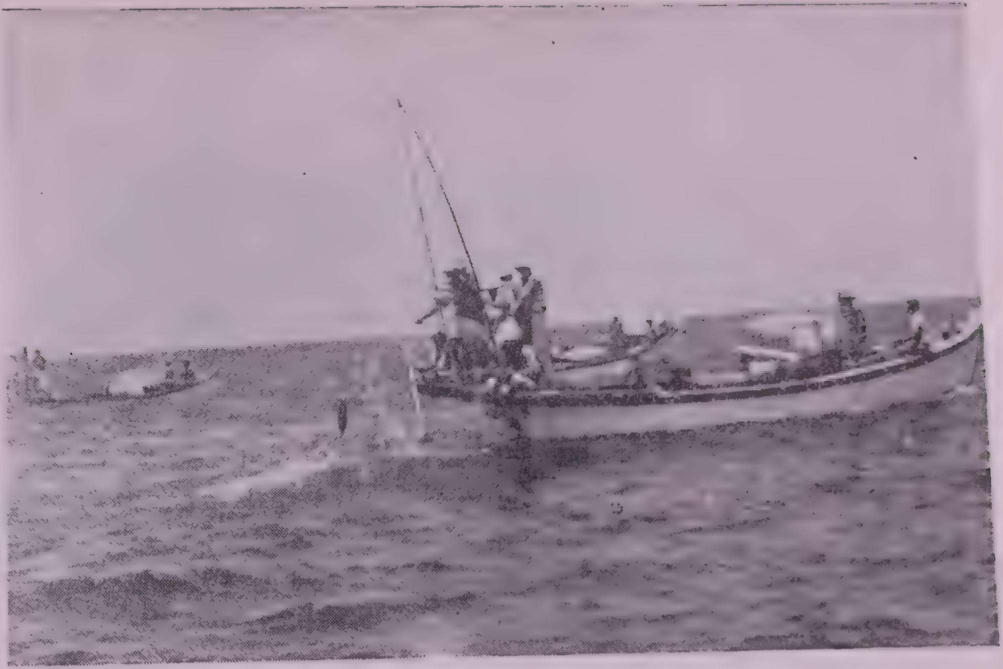

Fig. 6. Pole and line fishing for skipjack tunas off Agatti island.

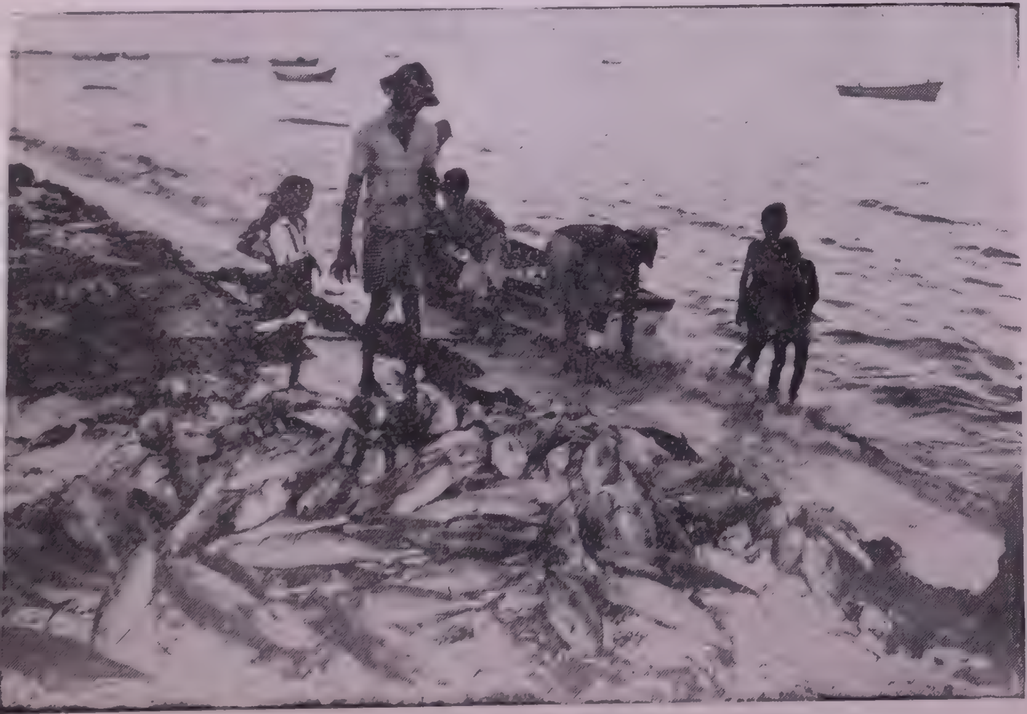

Fig. 7. A good catch of skipjack tuna being landed at Agatti Island.

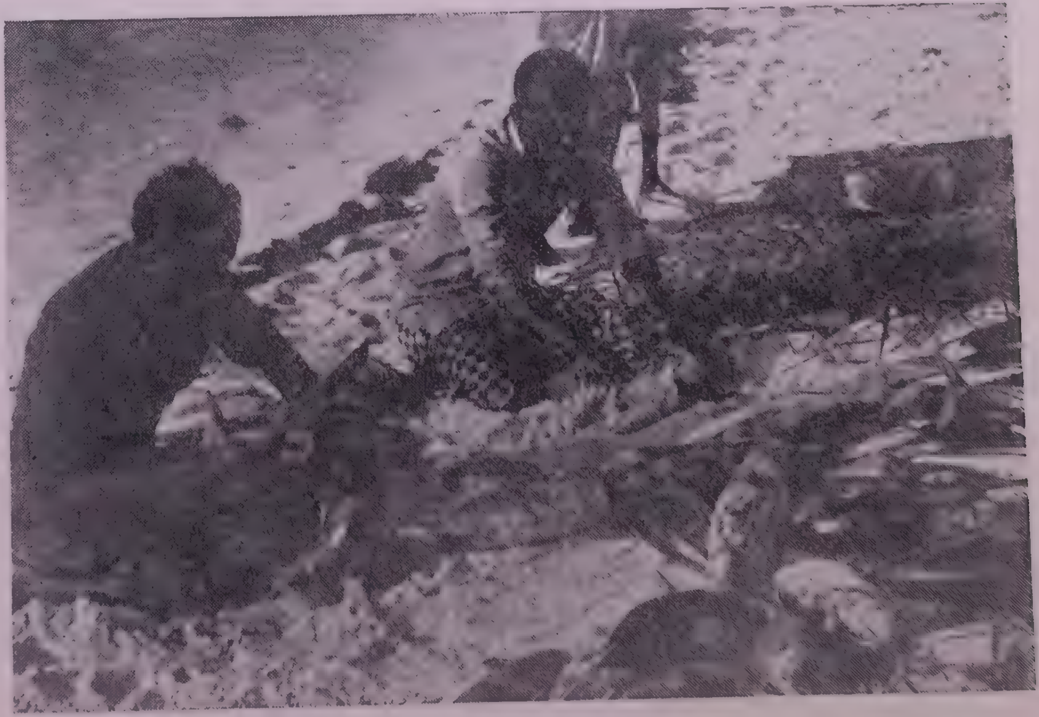

Fig.8. Tunas being cut in a characteristic style for the preparation of 'masmin' at Agatti Island.

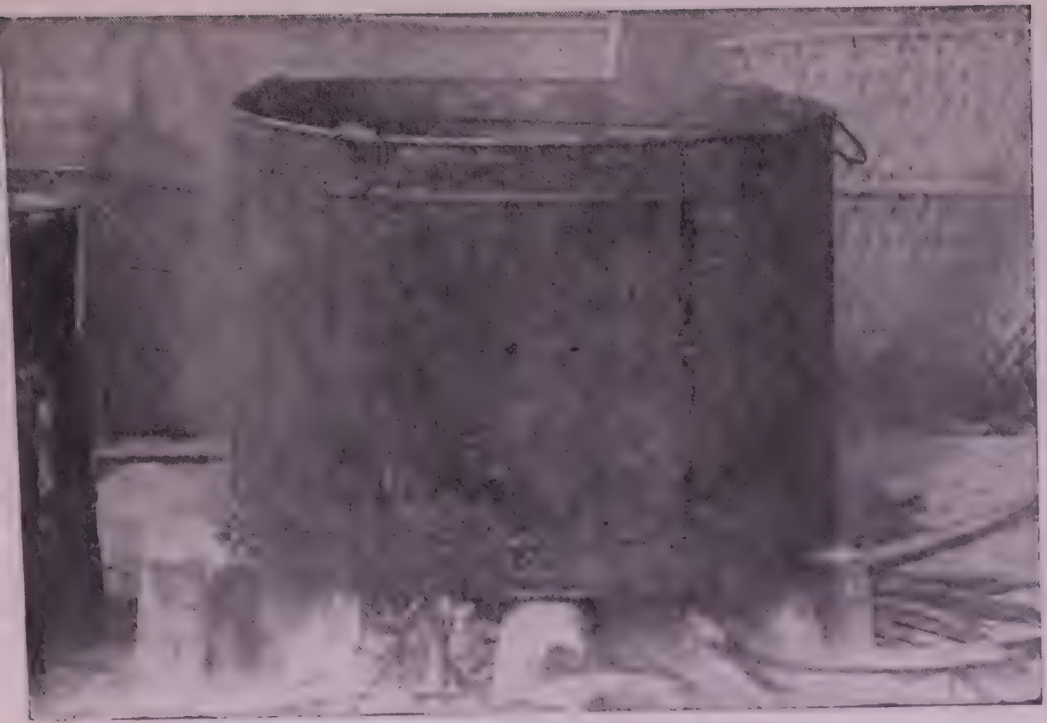

Fig. 9. Boiling of cut tunas in brine before smoking at Agatti Island.

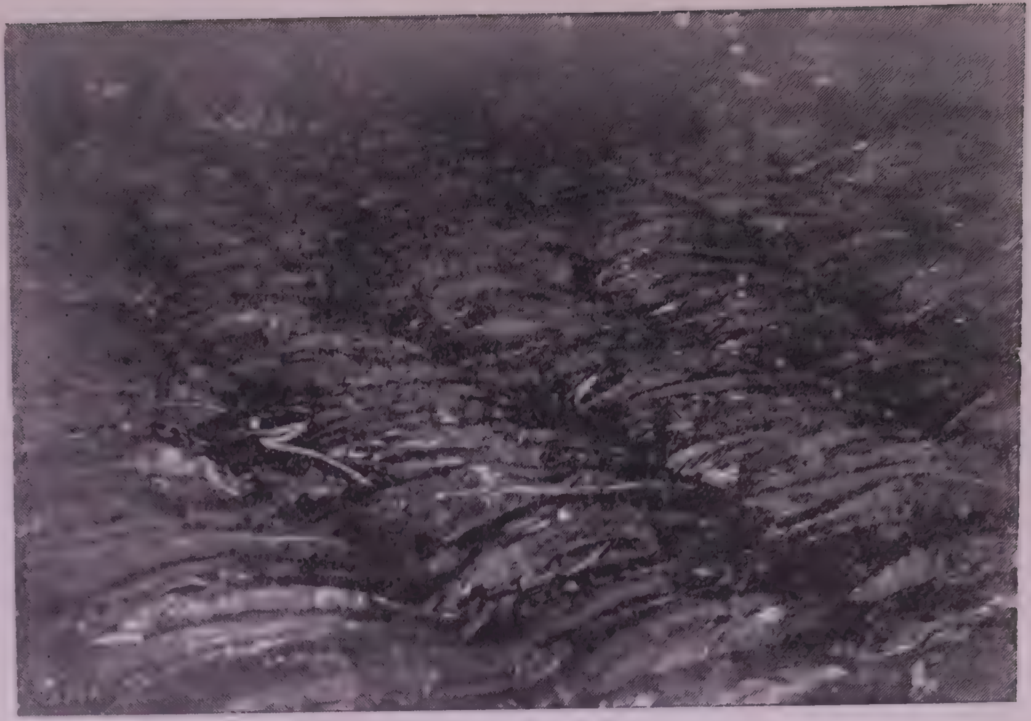

Fig. 10. Sundrying of boiled and smoked tunas at Agatti Island.

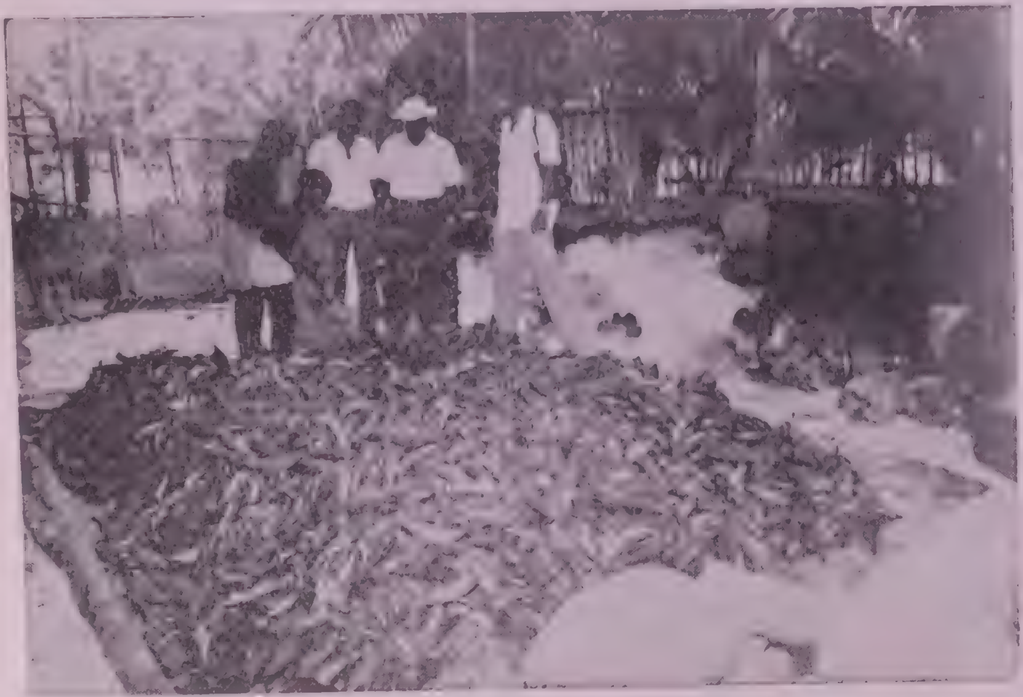

Fig. 11. 'Masmin' ready for packing and exporting at Agatti Island.

Fig. 12. A pit in which tuna wastes are buried on the beaches of Agatti Island.

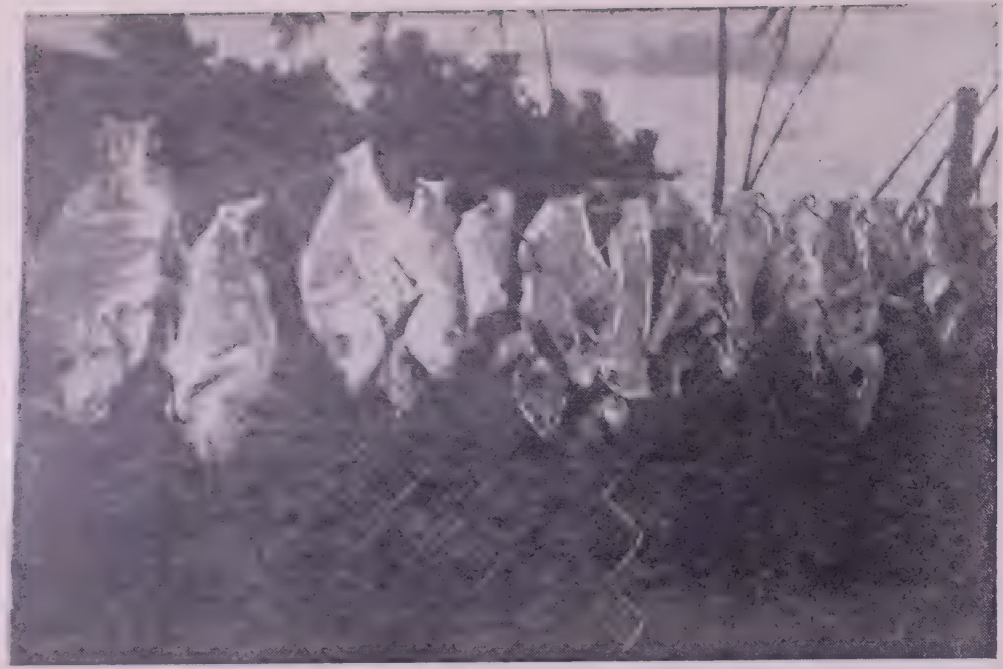

Fig. 13. Sundrying of other species of fishes (Lethrinids and **Lutjanids**) which are exploited on a limited scale from shallow waters of the lagoon **at Agatti** Island.

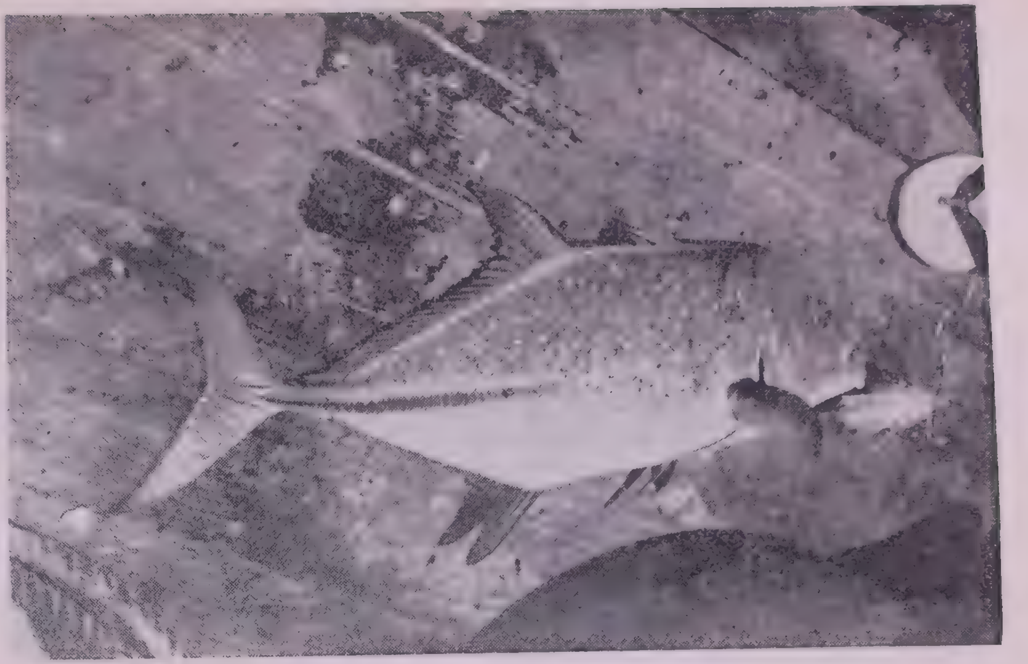

Fig. 14. *Caranx melampygus* caught on hook and line from deeper waters in Lakshadweep.

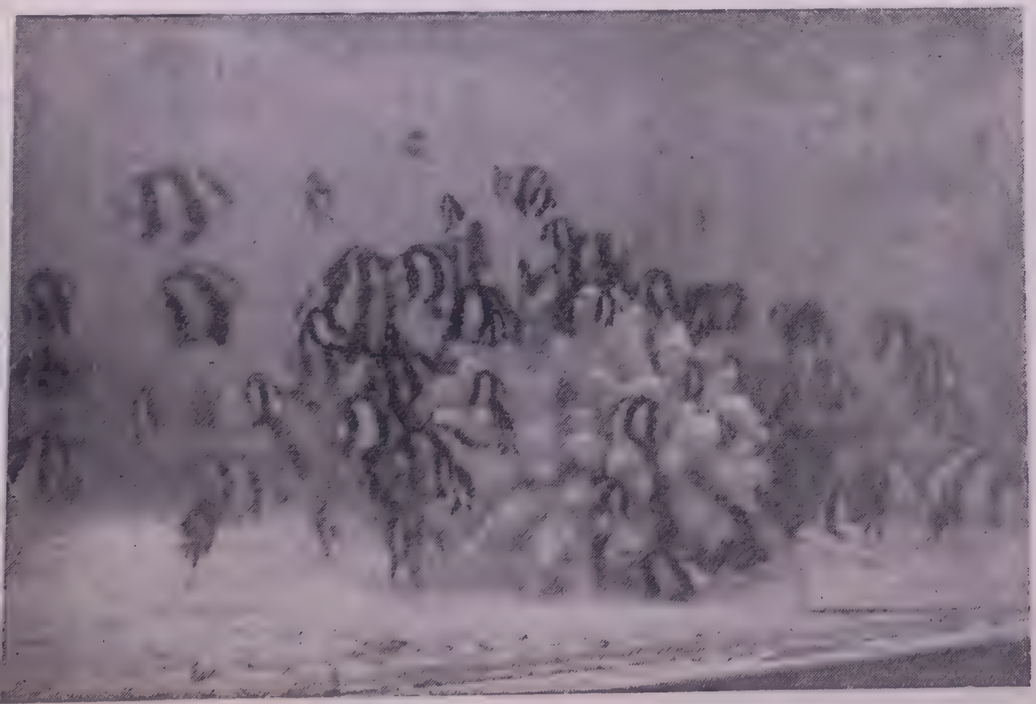

Fig. 15. A group of the marine ornamental fishes, *Dascyllus aruanus* maintained in the field laboratory of Minicoy Research Centre of CMFRI for the studies on behaviour.

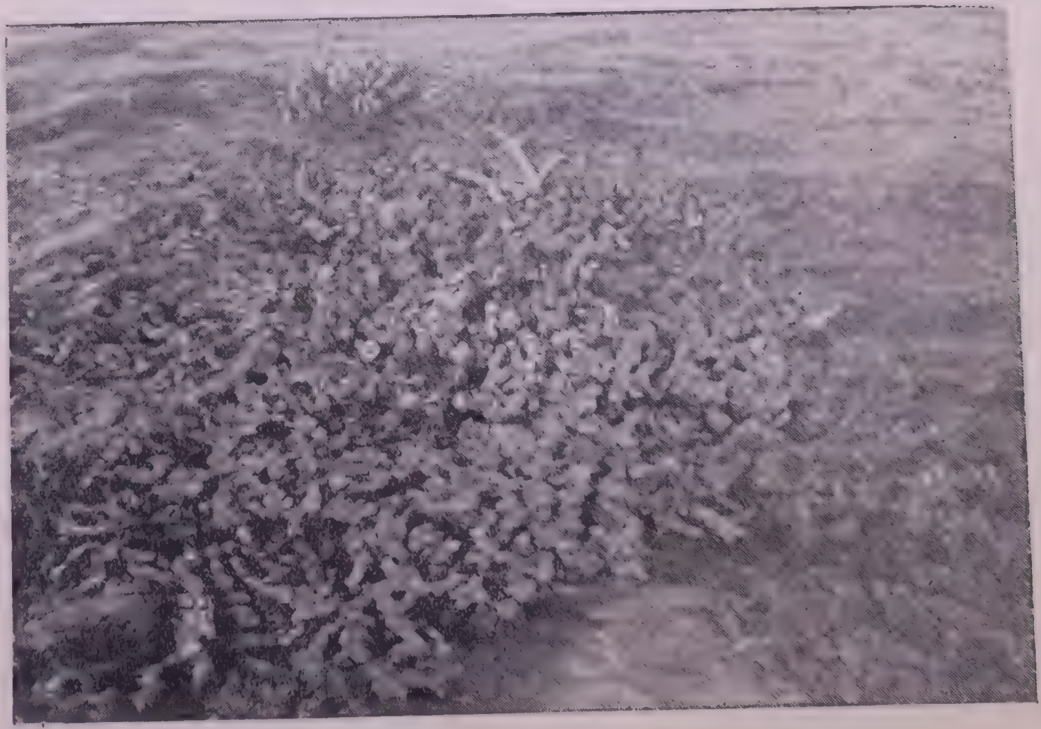

Fig. 16. An exposed reef flat in Bangaram Island during low tide.

The reason for the low rate of hooking appears to be the poor response of fish to the live-baits. Observations simultaneously made in the surrounding waters indicated abundance of small forage fish, possibly sprats and apogonids. Examination of gut content of a few fish caught at the same time indicated that the fish had already fed heavily on the carridean shrimp *Leptochela robusta* Stimpson which constituted about 90% of the volume. In view of the condition of the feed, it is presumed that although live-bait was chummed, since the fish had already fully fed, the response of the fish to the live-bait was poor. Therefore, the factors that determine the variations in the hooking rate, whether it be the presence or absence of forage fishes in the water at the time when the fishermen supply the live-bait or the condition of feed at the time of fishing or even environmental, need detailed study.

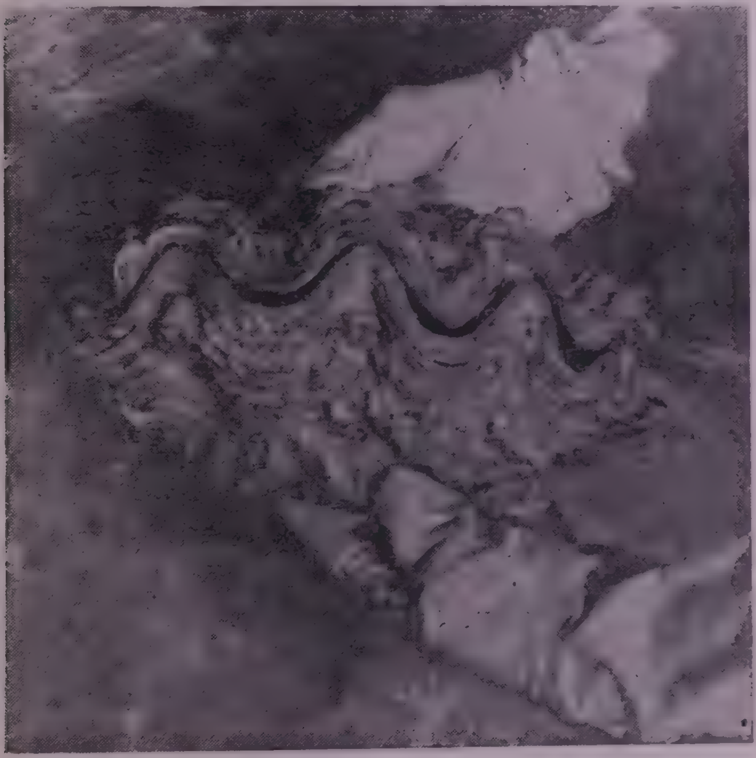

Fig. 17. The giant clam *Tridacna* sp. found in the lagoon of Bangaram Island.

Earlier studies (1958–'59) at Minicoy on the food of skipjack showed that crustaceans formed the major item and consisted of stomatopod larvae, mysids, euphausiids and *Acetes indicus*. Fishes such as balistids, monacanthids, syngnathids, young ones of *Dactyloptena* sp., tetradontids, carangids, *Triacanthus* sp., *Sphyraena* sp., *Ostracion* sp. and antennarids were encountered. Later studies during 1960–'61 revealed that the fish constituted 69.5% followed by crustaceans and stomatopods 8.9% and miscellaneous items forming 2.7%.

The processing of skipjack for preparation of the traditional product called 'masmin' was studied in detail. The fish are sliced in a particular manner as soon as they are brought ashore, and meat required for '*masmin*' is separated from the bones which is used for conversion into product called 'riha akru' used for flavouring the curries. The discarded materials from each fish including the head, gills, entrails and gonads are gathered together and buried in a very shallow pit along the beach. This waste from an individual fish of 4–5 kg amounted to about 1/2 kg. Therefore, the waste accumulated from tonnes of fish caught each day is enormous and this can provide good raw material either for conversion into fish ensilage or simply a manure to be used for plantations, especially the coconut, which is abundant in the islands.

The 'masmin' preparation is a very simple and quick process, locally managed by the boat owners/fishermen. The meat is straight away cooked in large urns in salt water for one or two hours. The cooked meat is removed and placed on metallic grills below which the smoke is produced using the waste from coconut trees. Smoking is done for a few hours and the smoked product is dried on the beach on coconut palm-leaf mats for about a week. The finished product is black in colour, very hard and without any odour. It is then put in gunny bags and transported by boat to different parts on the mainland for marketing. From a tuna of 4–5 kg in weight, about one kg of 'masmin' could be obtained and the price is Rs. 28 to 30 per kg. On the mainland, especially in Calicut, one kg of 'masmin' may cost Rs. 55 to 60. The annual production of 'masmin' amounts to 500 tonnes, worth Rs. 1.5 crores.

Different methods of disposal of the tuna waste are adopted in different islands. It is done hygienically in the Minicoy Island, where all the wastes are gathered and taken to far off places from human habitation and activity and dumped into coastal waters. In Agatti Island these wastes are buried in shallow pits all along the beach where the tunas are landed. This appears to be very unhygienic since such activities seem to generate unhealthy conditions resulting in development of maggots and flies which are commonly found even in the residential areas. It is suggested that such wastes should be profitably converted into fish ensilage (for use in mainland, if economically feasible) or atleast as manure in an organised manner.

While pole and line fishing is very successful under the present conditions existing in the islands, it cannot be concluded that the greater part of the natural resource of skipjack occurring in the area is fished. The potential for skipjack in the Lakshadweep Sea is great that it will be worthwhile to attempt an organised fishery by

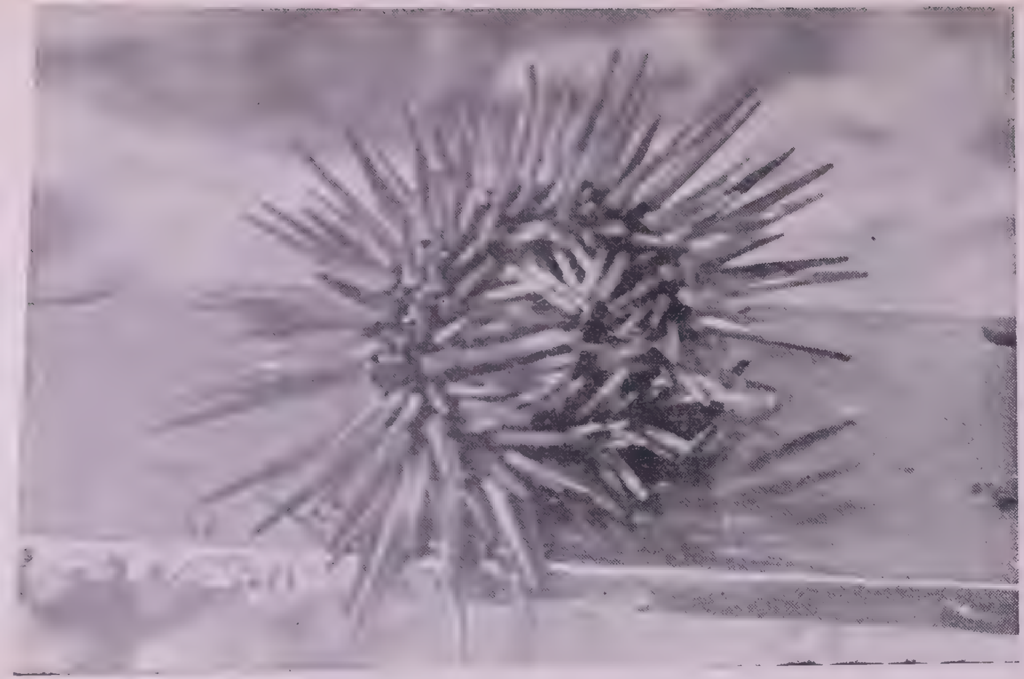

Fig. 18. *Echinometra mathaei*, a small sea urchin found associated with the corals in the lagoon of Bangaram Island.

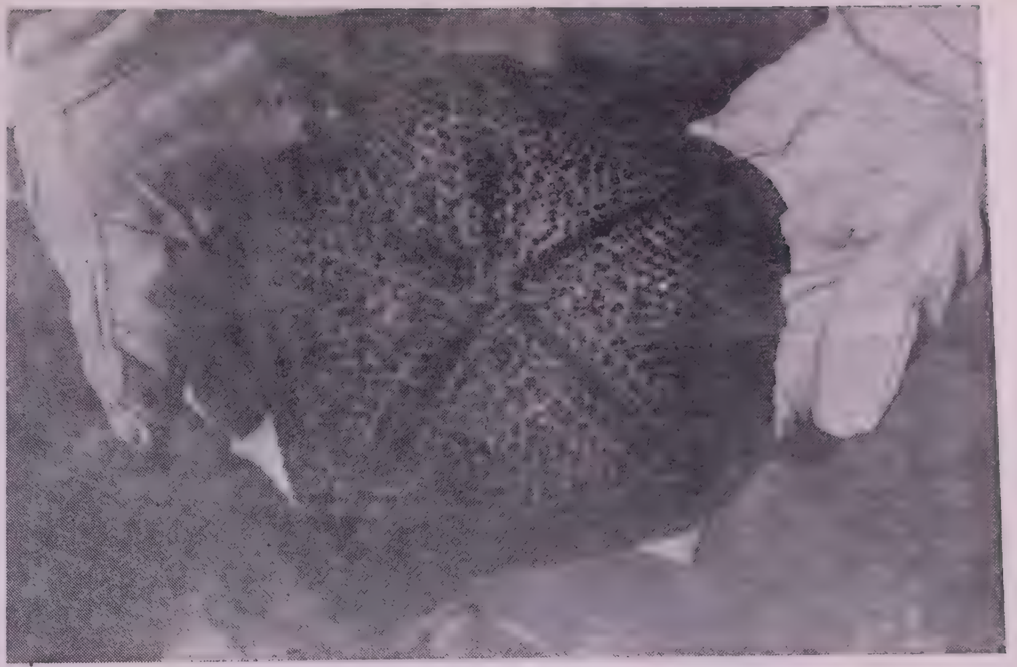

Fig. 19. *Culcita novaeguineae* (ventral view), an asteroid collected from the lagoon of Bangaram Island.

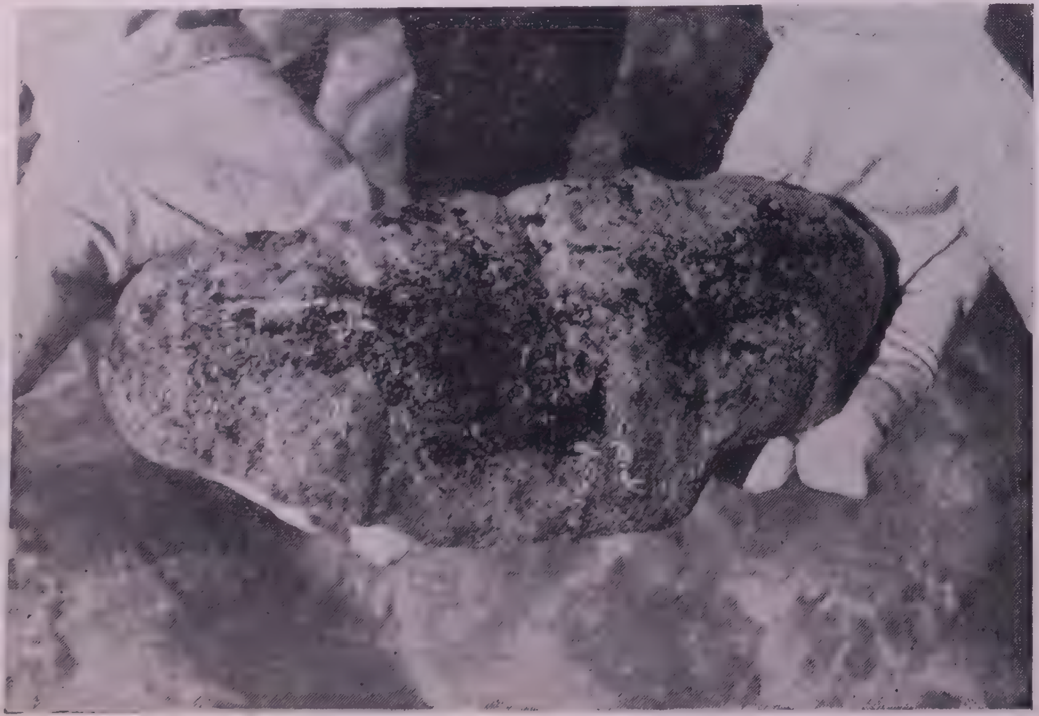

Fig. 20. *Holothuria (Microthele) nobilis* (dorsal view) collected from the lagoon of Bangaram Island.

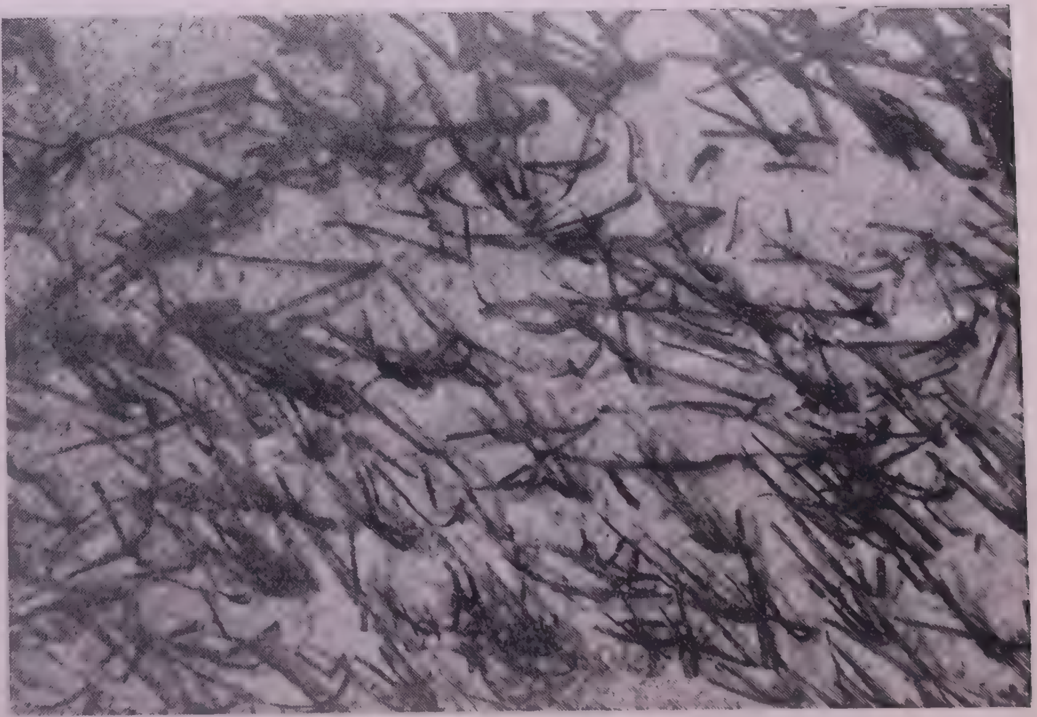

Fig. 21. A sea grass bed *(Thalassia hemprichii)* found exposed during low tide in the Bangaram Island.

purse seining which can harvest larger quantities of this resource. The constraints appear to be the lack of boats, expertise and labour needed for such fishing. It will be worthwhile to initiate purse seining in the area on a limited scale and monitor the effect of purse seining on the stocks, and the relationship between pole and line fishing and purse seining. Although a few specimens of yellowfin tunas, mostly young ones, are now and then caught in the pole and line fishery in the different islands, compared to skipjack, the yellowfin appears to be scarce. The possibilities of operating long line for yellowfin in the region should be examined by conducting experimental fishing since this method is more appropriate for this species.

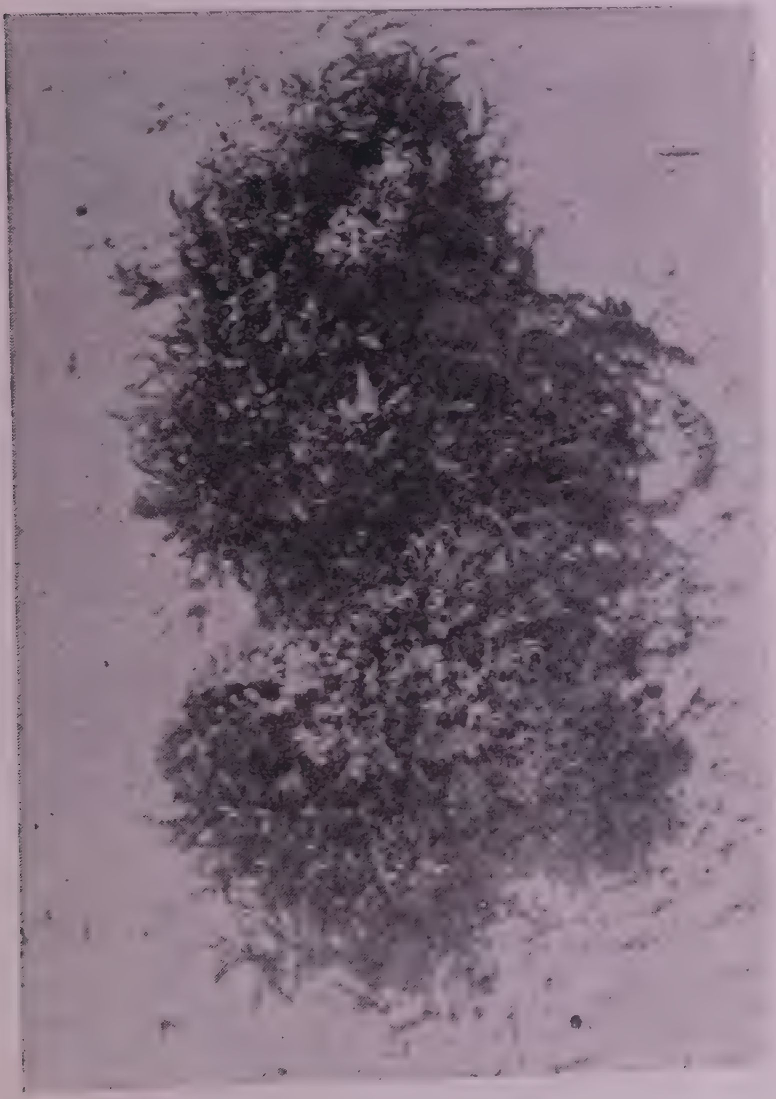

Fig. 22. The red alga *(Gracilaria crassa)* found growing on live and dead corals in the lagoon of Bangaram Island.

There is ample scope for development of tourism in the Lakshadweep islands. The aquarium and the museum maintained by the Fisheries Department of the Lakshadweep Administration have won already the appreciation of dignitories and tourists alike. Sport fishing can also attract tourists. The extensive lagoons and the surrounding waters and the stretches of inter island waters between closely placed islands abound in fishes such as carangids, lethrinids, lutjanids and even tunas and billfishes which can be taken on hooks and lines. Necessary steps to provide facilities like boats and gear for sport fishing as part of tourism development may be taken at suitable islands.

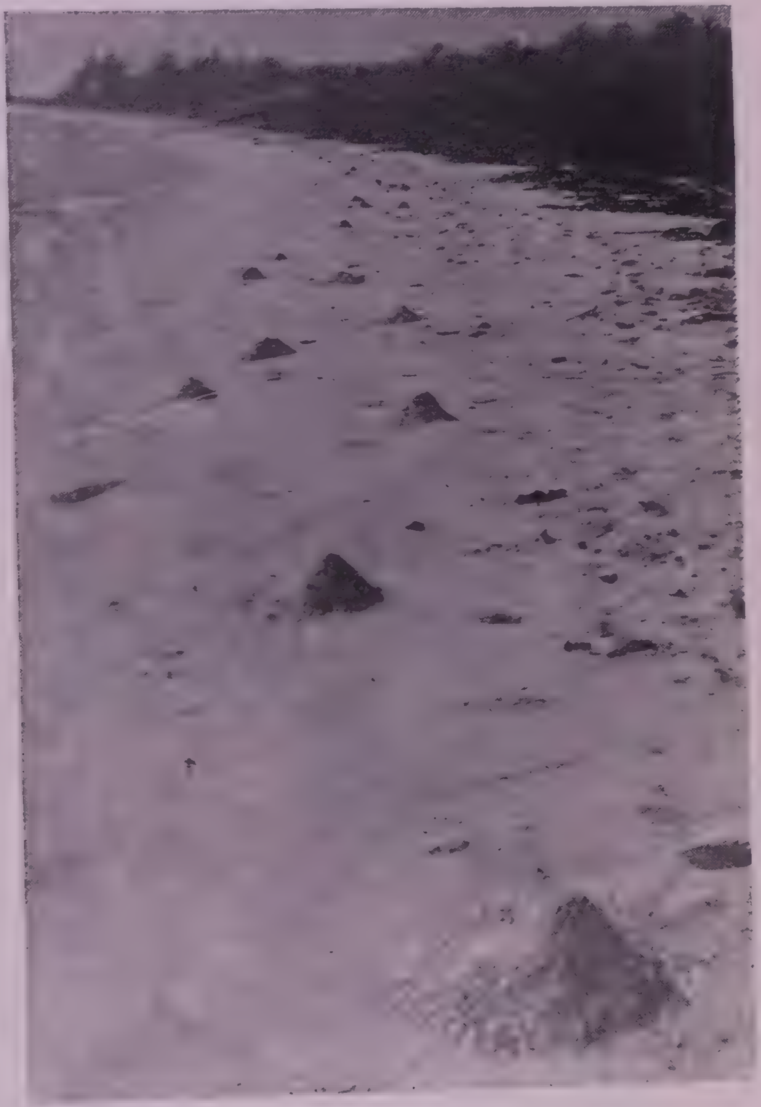

Fig. 23. The holes made by the ghost crab *(Ocypoda ceratophthalmus)* and the heaps of sand thrown out by them on the beach of Bangaram Island.

In view of the damages caused in some of the islands due to dredging and resultant effects on the coral reefs and associated fauna it is desirable that urgent steps are taken to declare some suitable areas as marine resources reserves or marine parks to preserve the coral reef ecosystem. However, location of such marine park will have to be decided upon by detailed studies including underwater surveys.

ROLE OF WOMEN IN SMALL SCALE FISHERIES – A CASE STUDY

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The studies conducted in India and a few countries abroad on the socio-economic conditions of the fishing communities have highlighted the role played by women in small-scale fisheries. The socio-economic structure of small-scale fisheries in India is very complex and there are many factors which influence the participation of women in fishery related activities. To identity these factors, a case study was carried out in Vypeenkara, one of the important fishing centres in Kerala.

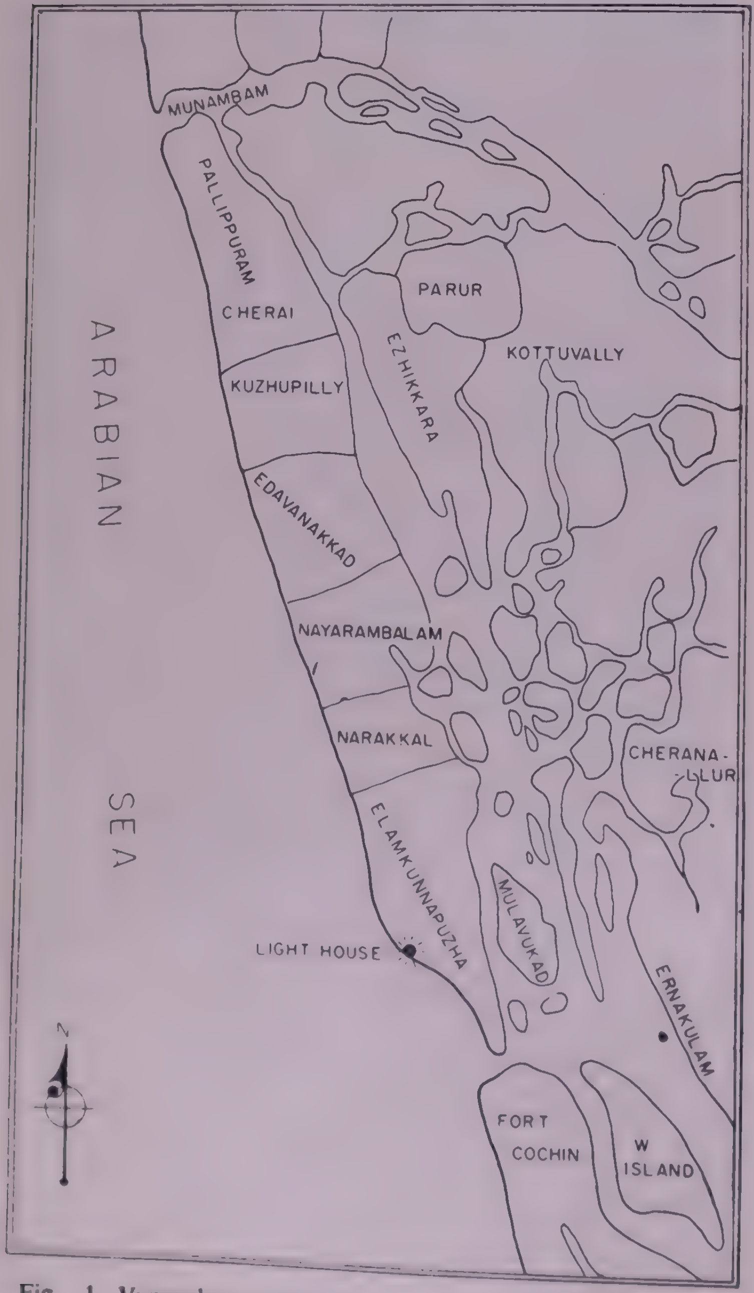

Fig. 1. Vypeenkara the area where the case study was conducted.

Data base

Data collected through a survey in Vypeenkara forms the basis for this study. A sample of 500 households covering 11 fishing villages coming under the jurisdiction of 6 panchayats were selected. An interview schedule was administered to the female head of the households which gave information on 1,148 women. Observations were also made in landing centres, curing yards and processing units.

In terms of the infrastructure facilities the Island was divided into three regions; Region – I consisting of Elamkunnapuzha Panchayat, Region - II consisting of Narakkal, Nayarambalam, Edavanakkad and Kuzhupilly panchayats and Region - III consisting of Pallipuram Panchayat for the purpose of this study. The

Table 1. *Regionwise distribution of villages and number of households*

Region	Panchayat	Fishing villages	No. of households selected	Percentage of Male	Percentage of Female	Percentage of Children
I	Elamkunnapuzha	Murikkumpadam, Ochanthuruthu	35	36	37	27
II	Narakkal	Narakkal	40	37	36	27
	Nayarambalam	Nayarambalam	35	34	35	31
	Edavanakkad	Edavanakkad	35	31	34	35
	Kuzhupilly	Kuzhupilly	35	34	35	31
		Ayyampilli	35	34	35	31
III	Pallipuram	Cherai	40	40	38	22
		Pallipuram	65	35	34	31
		Munambam	85	36	36	28
	Total		500	36	36	28

households falling along the western side of the Island where most of the marine fishermen lived were mainly considered for the study. (Table 1, Figure 1).

Areas of women's participation

Prawn peeling, fish curing, drying and marketing, net making, fishing in the canals and clam shell collection are the major areas of women's participation. About 20% of the women population was estimated to be engaged in the fishery related activities. This figure, however, does not indicate the employment status of the women as none of the activities assure regular employment or income nor a distinct line can be drawn among various groups engaged in different activities as these activities are quite often not mutually exclusive.

Prawn peeling

Peeled prawn is an important item of foreign exchange earner to the country. Prawn peeling is a seasonal activity coinciding with prawn fishery season, the peak being August–November. In prawn peeling two types of activities are observed. They are (i) peeling in the centralised units such as peeling sheds rented in by agents (Fig. 3) and (ii) peeling in decentralised units such as homesteads. Peeling does not require any special skill though some variation is seen in the percentage of meat recovery from person to person. In a peeling shed of 3 x 4m area, about 10–15 women are engaged at a time, and depending on the quantity of prawn available the number of women engaged also varies. Peeling is carried out under the supervision of the agents who distribute weighed quantity of prawn among the women. A woman can peel about one kg of prawn in an hour and can earn a maximum of Rs. 6 per day at the rate of 50–75 paise per kg. During the peak season peeling goes on day and night. Prawns landed by mechanised boats are generally peeled in such units. These peeling sheds are mostly located near the landing centres.

There are about 85 registered peeling sheds according to panchayat records and several others without registration in the Island. Among registered sheds 60 are located in Region - III *i.e.* Pallipuram Panchayat. There are also sheds where prawns from filtration ponds are peeled. In view of the cost incurred towards rent and difficulties in maintaining the prescribed hygienic standards, there is a tendency among the agents to get the peeling done in decentralised units by distributing the prawns among the households in the vicinity of the landing centres. In decentralised peeling, two systems are followed. In the first, the agents distribute 1 or 2 kg of prawn among the households of the locality and get it peeled at certain rate. In the other, prawn is sold to the local women and meat is bought back. In the former system the labour charge is paid whereas in the latter the payment is based on meat recovery. Peeling agents do not employ women on regular basis as they should be covered by Minimum Wages Act, if done so. Peeling is also done in households which own crafts and gears where women from neighbourhood are engaged and the meat is sold to the agents or to the processing units. In the sample selected, 25% of the women are found to participate in prawn peeling.

Curing, drying and trading of fish

In the backwater fishing using stake nets and chinese dip nets, once the catch is landed women take over the entire post-harvest operations namely sorting, (Fig. 4) on-the-spot auctioning, gutting and salting (curing), drying, carrying the dried fish to market in the mainland and trading it. These women mostly belong to 'Vaala' community. The fish is processed daily but is taken to the market only twice a week. A woman takes about 30 kg of fish at a time for trading. The processed fish is transported to the mainland (Ernakulam) in canoes and women travel by bus to the boat jetty and then to the mainland by ferry. The fish is sold at both retail and wholesale rates. A net profit of Rs. 15–20 is earned by a woman twice a week. There are also women who buy fresh fish from boat owners and traders, usually on credit, and the money is paid back after disposing the processed commodity.

In fish curing and drying also centralised type of activity is seen (Fig. 5). But out of the 45 curing yards (most of which are available at Pallipuram Panchayat) only a few are functioning regularly. These yards engage one or two women on weekly wage at the rate of Rs. 10–15 per day. Curing of fish is practiced on the sea shore by small traders with the help of a few women. Marine fisherwomen are also found to be engaged in trading of fresh and dry fish as vendors. In icing and other activities in the processing units, participation of women is found to be very rare. The participation of women in curing and drying and in trading is estimated at 19 and 20% respectively.

Net making

Net making is the traditional skill of 'Araya' community though women of other communities also have learnt the job. Women in some part of Elamkunnapuzha, Puthuvaippu and Narakkal engage themselves in hand braiding of fishing nets (Fig. 7). Net making is a leisure time activity. Net mending is done by men during their leisure. The cotton and silk threads have been replaced by nylon yarn and braiding of nylon net for boats is the most important activity. Agents for net making distribute about 200 kg nylon yarn among 40 households at a time. Normally a period of one month is required to complete the job. A woman can braid a maximum of one kg net a week. The labour charges work out to Rs. 3 per 100 mesh and a woman can earn Rs. 20 per week through net making. Though hand braided nets are considered to last longer, net making for own use is not considered worth the effort as it is a time consuming activity. Moreover the gains do not compensate for the labour put in. The net making by women is reported to be decreasing with the establishment of nylon net factories. Eighteen per cent of women in the sample are estimated to be engaged in net making.

Fishing in the canals

Fishing in the canals and the impounded water areas for prawns and priced fish such as pearl spot during the low tide is one of the important activities of women belonging to 'Pulaya' community in areas where prawn/fish farming activities take place. Women move in water in a line with narrow-mouthed aluminium and earthern pots in their hands (Fig.2). A bunch of leaves is inserted into the mouth of the pot which prevents the fish collected in the pot from escaping. The fish and prawn are caught by searching with hands. An income of about Rs. 20 per day is earned by women, if she gets a good catch. The 'Pulaya' women also help their husbands in cast-netting and collection of prawn larvae from the surf. During the paddy season they engage themselves in agricultural operations.

Collection of clam shells

During the monsoon due to fresh-water influx marine clams are washed ashore. The women from Pallipuram Panchayat area collect these shells and sell to the clam shell society or the agents at the rate of Rs. 2.50 per basket of 20 kg and earn about Rs. 10 per day. July–September is the main season for clam shell collection, but women and children are found engaged in this activity throughout the year. During certain seasons collection is done during the night. Women stand in knee-deep water and scoop the clams with the help of an iron plate called *'Odu'* and collect them in *'vatta vala'* (Fig. 6). Clam shells thus collected are heaped

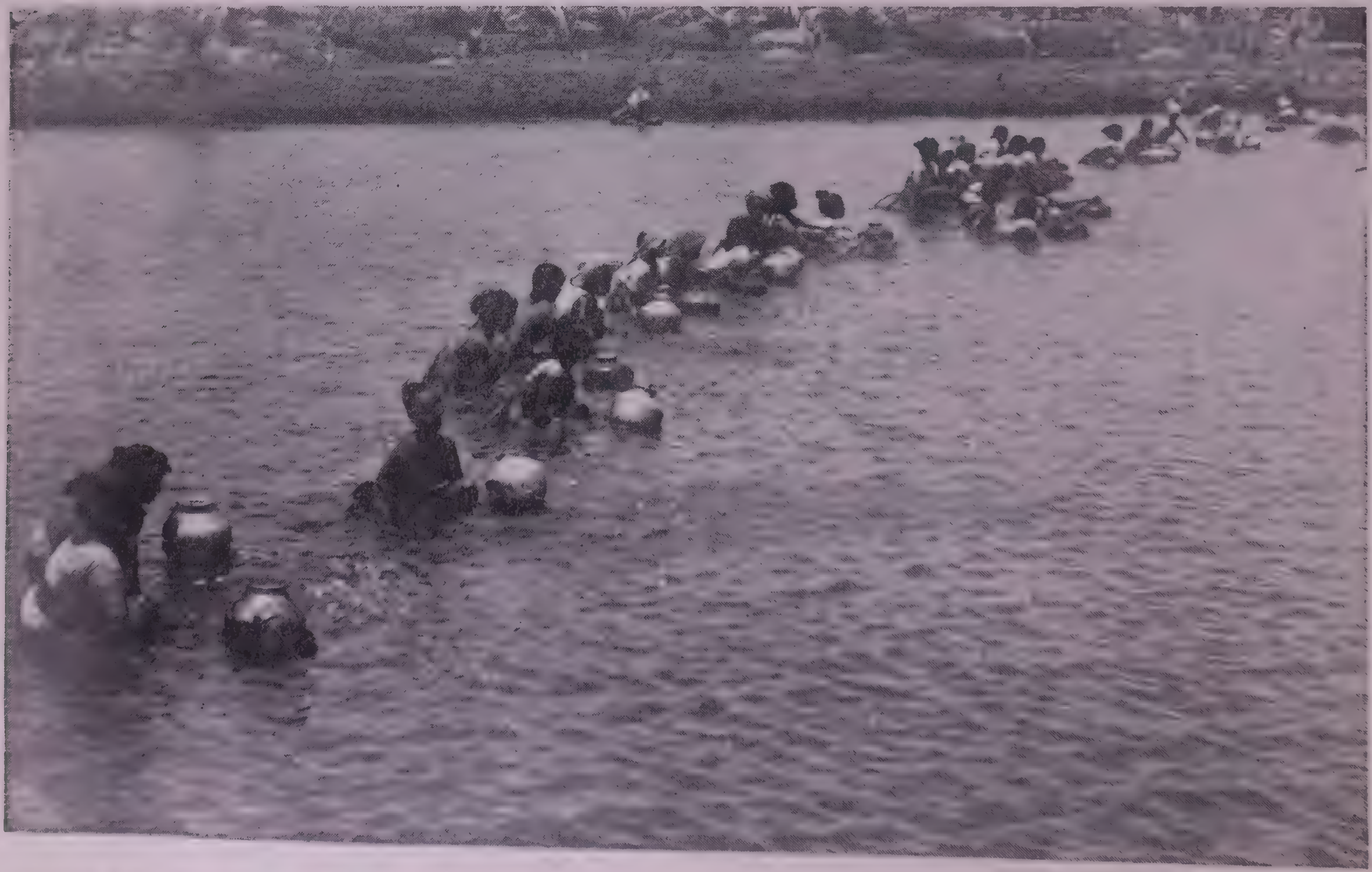

Fig. 2. Hand picking of prawns and pearl spots by women is an age old practice for harvesting prawns from culture farms.

on the beach by the agents and when good quantity is collected the same is loaded in trucks and sent to other states mainly Tamil Nadu to be used in lime industry. The loading of shells in the trucks is also done by women.

Fig. 3. Prawn peeling is an almost exclusive job of women.

A total of 20% of fisher women is estimated to be participating in the above activities together. Table 2 gives the average number of hours a woman engages in the different fishery-related activities and average income per day.

Table 2. *Average number of hour of occupation and income earned per hour*

Activity	Average hours occupied in a year (No. of days & No. of hours)	Average income per hour (Rs.)
Prawn peeling	1,080 (180 x 6)	0.50
Drying and trading of backwater fish	1,080 (180 x 6)	0.50
Net making	900 (300 x 3)	0.45
Clam shell collection	720 (120 x 6)	1.42

Women's participation in fishery-related activities

Availability of infrastructure facilities

The availability of infrastructure facilities was found to be the major factor influencing women's role in fishery related activities. A significant relation was found between different regions divided in terms of availability of infrastructure facilities and participation of women in different activities. The households in parts of Elamkunnapuzha in Region -I and Pallipuram Panchayat in Region - III have better infrastructure facilities in terms of landing centres, peeling sheds, bus stand and boat jetty, which facilitate them in processing and transporting the commodity to the market. In Region - I households have access to both backwater and sea fishing. The villages in Region - II in the middle section of the Island are far from the main road and do not have adequate infrastructure facilities for processing and marketing of fish and hence the fish catch is sold off by fishermen in the landing centre. As a result, women in this region do not get enough opportunities to gainfully engaging themselves. In certain parts of these marine fishing villages women have to spend major part of their time in fetching drinking water from road side public hydrants.

Caste

Distribution of different castes in each activity is presented in Table 3. In peeling, the major participation is found to be that of 'Kudumbis' and 'Vaalas' with substantial participation by other communities also. Drying and trading is dominated by 'Vaalas' whose main household occupation is backwater fishing. In net making 'Arayas' have the major contribution estimated at 60% as the activity is the traditional skill of the community. Fishing in canals is dominated by 'Pulayas' and major participation in clam shell collection comes from 'Kudumbis'.

Table 3. *Caste-wise distribution of women engaged in various activities (%) (participation in each activity is not mutually exclusive)*

Caste	Peeling	Curing and trading	Drying	Net making	Fishing in canals	Clam shell collection	Others
Araya	14	16	3	80	—	—	8
Vaala	20	72	77	2	—	—	18
Christian	11	5	11	10	—	—	30
Ezhava	12	—	4	6	—	—	26
Kudumbi	26	5	0	2	—	88	4
Pulaya	12	0	3	—	100	—	—
Others	5	2	2	—	—	12	14
Total	100	100	100	100	100	100	100

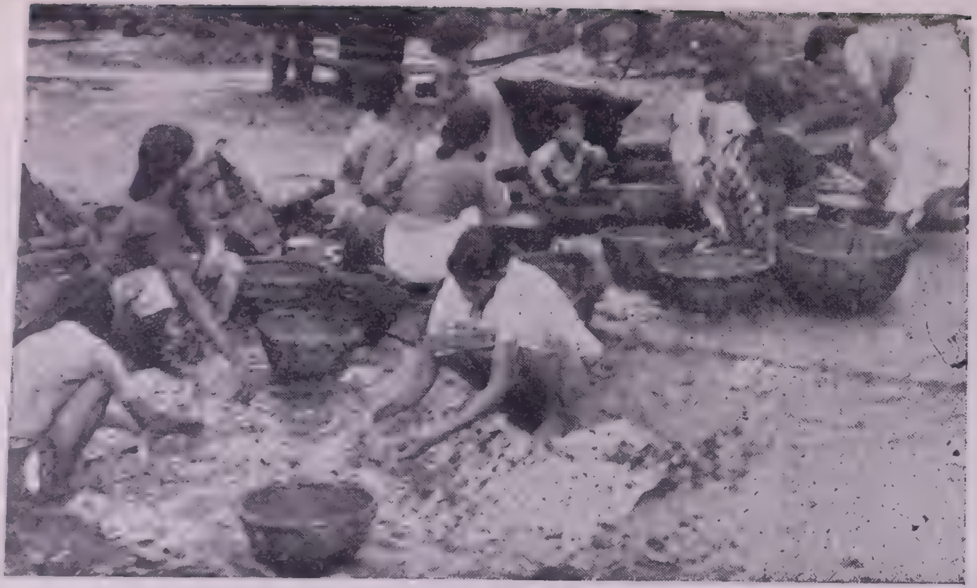

Fig. 4. Women engaged in sorting of fish into different groups.

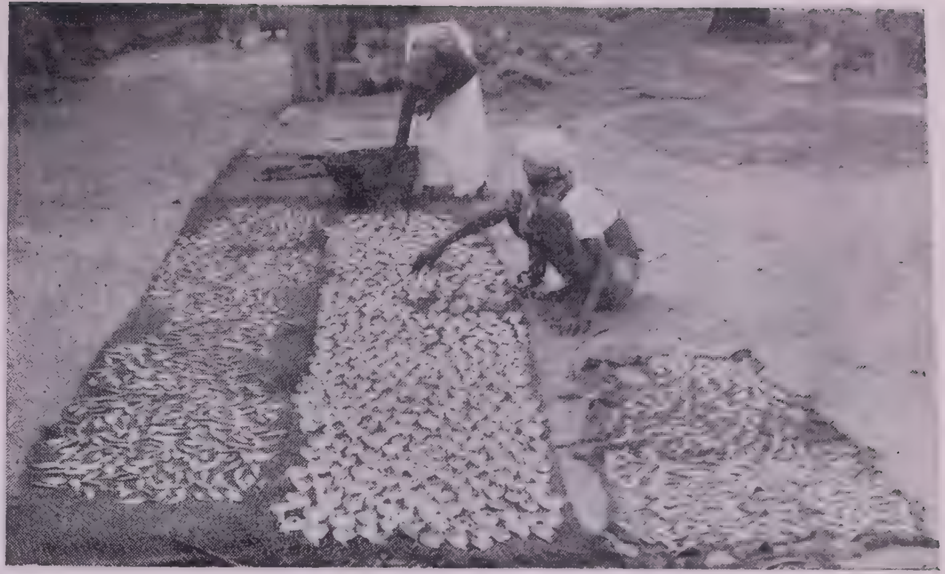

Fig. 5. **Fish drying in homesteads**, another women oriented job.

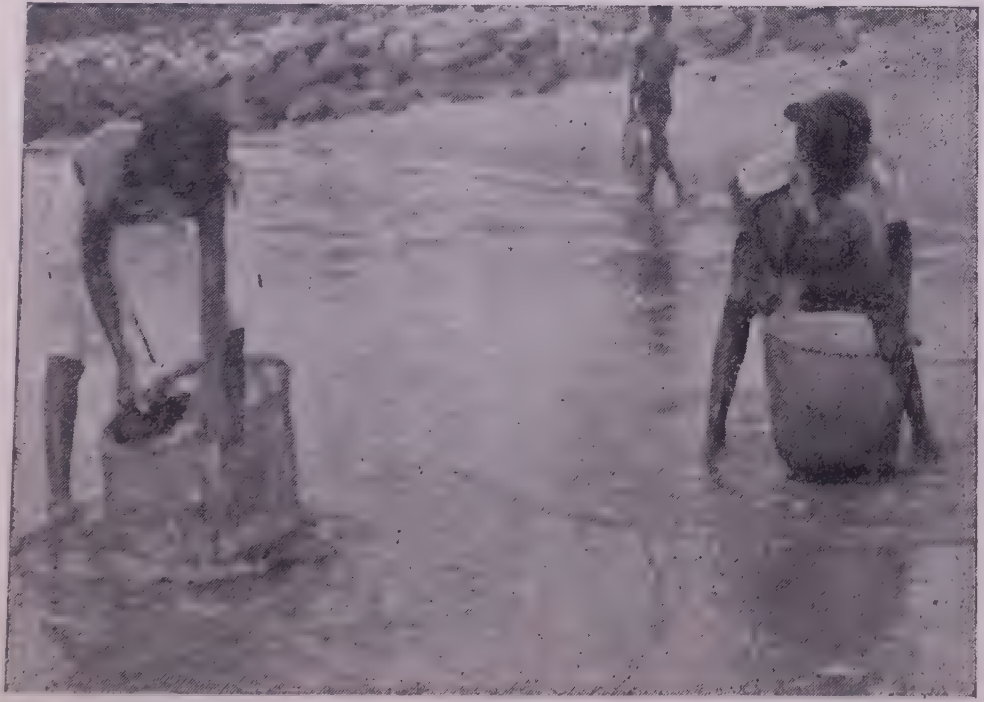

Fig. 6. Women and children make a living out of clam shells filtered out of sand in the estuaries and backwaters.

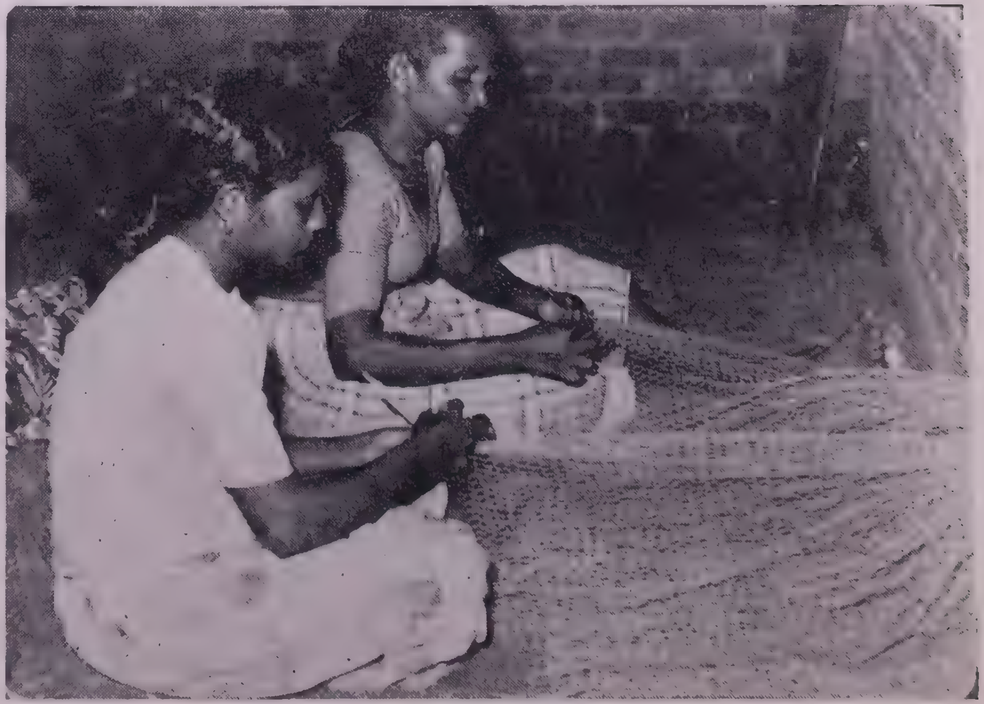

Fig. 7. Skilled work like hand braiding of fishing nets is also handled by women of coastal areas.

Age group and education

It can be seen from Tables 4 and 5 that most of the women in the sample who participate in peeling are in the age group of 13–40 with education upto secondary (VIII to X standard) level. In net making also women of the same age group have higher participation but the educational level is found to be at primary and below. In the case of curing and trading the major participation is from the age group of 40–49 with education below primary level.

Table 4. *Age-wise distribution of women in different activities (%)*

Age group (years)	Peeling	Net making	Curing and trading	Drying	Fishing in canals	Clam shell collection	Others
< 13	9	0	0	0	2	9	—
13–24	43	20	0	0	10	15	—
25–39	35	63	22	30	37	17	—
40–49	7	10	60	50	38	38	—
50–60	3	4	18	20	7	3	—
> 60	3	3	0	0	6	18	—
Total	100	100	100	100	100	100	—

Table 5. *Education-wise distribution of women in various activities*

Education level	Peeling	Curing and trading	Drying	Net making	Fishing in canals	Clam shell collection	Others
< primary	20	81	81	51	89	60	58
Primary	28	18	19	37	2	33	26
Secondary	41	1	0	10	9	7	10
>secondary	11	0	0	2	0	0	6
Total	100	100	100	100	100	100	100

Among the women who participate in peeling, a good percentage can be accounted for those who go to the peeling sheds to do the job. The income thus earned is mainly used for buying personal requirements like clothes and cosmetics. In the case of other activities where women of higher age group participate the earning is added to the household income.

Remarks

Out of the sample selected for the study, a total of 20% is estimated to be participating in fishery-related activities, the major areas of participation being prawn peeling, curing, drying and trading of fish, net making, fishing in canals and clam shell collection. In prawn peeling and net making women of younger age groups have better participation. The participation is also, to certain extent governed by caste, though caste structure does not bar any section from engaging in the above activities. Availability of infrastructure is found to be the major factor influencing women's participation in fishery-related activities.

Women in general are hopeful of improving their lives through the development of fisheries activities in the Island and show readiness to acquire new skills and undergo training for the same. But poverty and to certain extent ignorance have hampered their progress. The inhabitants of the Island in general felt that the Island has been witnessing a transformation in fishery sector over the years and opportunities for women to engage in gainful activities have been declining. This is mainly due to the construction of fisheries harbour at Cochin and subsequent landing of mechanised crafts there, thereby resulting in considerable reduction in the volume of business coming to the Island. Improvement in the situation could be brought about by hastening the process of establishment of the village societies by the State Government for supply of improved fishing implements and improvement of landing facilities for mechanised crafts at Munambam. Co-operatives may be organised for women engaged in processing and trading of fish and training may be given in improved handling and processing techniques. In similar way, women can also organise themselves for net making on a co-operative basis. Aquaculture will be another useful enterprise for women as the Island has good potential for it. Development of the same may be accomplished through the concerted effort of centres like Krishi Vigyan Kendra.

A NOTE ON THE LONG LINE FISHERY AT SIKKA, GUJARAT*

Sikka is a small fish landing centre in the Gulf of Kutch, about 30 km north of Jamnagar. In the Village 135 fishermen families with a population of 995 members are actively involved in various fishing activities of which 494 are actively engaged in fishing. A total of 99 boats are in operation of which only eight are mechanised. Three types of gill nets, stake net and long line are the gears used for fishing. Of these the long line deserves special mention for they are being made out of old material and therefore economical.

The long lines locally known as 'Wagha' are made of polyethylene and nylon. The main line is about 400 to 600 m long and has a diameter of 4 to 6 mm. 200 to 300 hooks, locally known as 'Kundi' or 'Gill' are attached to the main line at an interval of 4 m by means of small branch lines of 1 m length and 2 mm diameter each having two to three hooks. Plastic cans of 20 to 35 litre capacity are used as floats and weights of 20–35 kg are used as anchors.

An interesting fact with regard to the making of long lines is that 80% of its material come from old gill nets. The main line is prepared from old head and foot ropes of gill nets while the branch lines of 2 mm diameter are prepared from twine obtained from the old webbing of gill net and old ropes, polyethylene, coir or jute. The lines for floats and anchor are also made from the webbings of the gill net. The split up cost and total cost of 400 m and 600 m long lines are given in Table 1.

Flesh of octopii is being used as bait in long line operation. The octopii locally known as 'Saravan' occur in plenty in the nearshore waters along the Sikka coast. The number of persons engaged in long line fishery varies from 4 to 7 according to the size of the boat. The fishing grounds are 10–20 km away from the coast where the depth may range between 20 and 30 m. During a trip 3–4 operations are carried out, each lasting for about 1–3 hours.

The catch usually brought by the long liners include 'Ghol', 'Koth', 'Dara', cat fishes, eels, perches and sharks. Special observations were made on the catch, composition, CPUE and price realised for nine boats and the data were used to calculate the same for the 35 long liners in operation at Sikka. The results are given in Table 2.

Table 1. *Specifications of long lines made out of old material*

Items	Size of rope/ twine & No. of hooks	Weight (kg) and number	Rates (Rs/kg/ No.)	Cost (Rs.)	
				400 m long line	600 m long line
Main line	4–6 mm	3–5	80.00	240	400
Branch line	2 mm	2–3	60.00	120	180
Hook	2–3	200–300	1.25	250	375
Misc. (Jerry can, anchor etc.)	—	—	—	150	300
			Total	760	1,255

Table 2. *Total catch, CPUE and income realised (estimated for a day)*

Group	Estimated catch (kg)	C.P.U.E. (kg)	Price (Rs.kg)	Income per boat (Rs.)
Cat fish	20,222	578	2.50	1,445
Ghol	1,003	29	8	232
Sharks	331	18	2	34
			Total	1,711

Due to the lack of infrastructure facilities such as ice plant, storage and transportation, fishermen are compelled to dispose off their catches to the middle men at the landing centre who in turn carry them to Jamnagar and from there the fish are being transported to Delhi, Bombay and Calcutta by train.

It has been reported by fishermen that the long line fishery is more lucrative at Sikka. The significant aspect in this regard is that, here the long lines are made exclusively of material recovered from old gill nets and hence very economical. The fishermen have further stated that they are interested to develop this gear but wish to be assured of a good price for their catches besides ice plant and cold storage facilities.

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*Prepared by S.G. Raje, Veraval Research Centre of CMFRI, Veraval.

MARINE ALGAL FLORA FROM SELECTED CENTRES ALONG THE MADRAS COAST†

A survey was made on the marine algae occurring at Pulicat, Kovalam, Muthukadu and Mahabalipuram along the Madras coast. The species recorded at the respective centres are given in Table 1. A total of 22 species were collected of which six species belonged to Chlorophyta, three to Phaeophyta, 10 to Rhodophyta and three to Cyanophyta. Out of the 22 species, 16 are recorded for the first time along the Madras coast.

The agar-yielding seaweeds *Gracilaria corticata* var. *corticata* and *G. verrucosa,* carrageenan yielding seaweeds *Hypnea valentiae* and *H. spinella,* algin yielding seaweeds *Padina tetrastromatica, Rosenvingea intricata* and *Chnoospora implexa* and edible seaweeds *Enteromorpha compressa, Ulva lactuca* and *Centroceras clavulatum* were present among the species collected. Detailed investigations throughout the year on algal composition at different localities along Madras coast are necessary to know the availability and seasonal variations of the different algae.

Table 1. *List of marine algae collected from four localities near Madras*

Sl. No.	Name of the algae	Pulicat lake	Kovalam	Muttukadu	Mahabalipuram
	CHLOROPHYTA				
1.	*Enteromorpha compressa* (Linnaeus) Greville	+	—	+	+
2.	**E. intestinalis* (Linnaeus) Link	+	—	+	—
3.	**Ulva lactuca* Linnaeus	—	—	+	—
4.	**Chaetomorpha antennina* (Bory) Kuetzing	—	+	—	+
5.	*Chaetomorpha* sp.	+	—	+	+
6.	*Cladophora* sp.	—	—	+	+
	PHAEOPHYTA				
7.	*Padina tetrastromatica* Hauck	+	—	—	—
8.	*Rosenvingea intricata* (J. Agardh) Boergesen	+	—	+	—
9.	**Chnoospora implexa* (Hering) J. Agardh	+	—	—	—
	RHODOPHYTA				
10.	**Grateloupia filicina* (Wulfen) J. Agardh	—	—	—	+
11.	**G. lithophila* Boergesen	—	+	—	+
12.	**Gracilaria corticata* var. *corticata* J. Agardh	—	+	—	+
13.	**G. verrucosa* (Hudson) Papenfuss	+	—	+	—
14.	**Hypnea valentiae* (Turner) Montagne	+	—	—	—
15.	**H. spinella* (C. Agardh) Kuetzing	—	—	—	+
16.	*Ceramium* sp.	—	—	—	+
17.	**Centroceras clavulatun* (C. Agardh) Montagne	—	—	—	+
18.	**Polysiphonia* sp.	+	—	—	—
19.	**Herposiphonia* sp.	—	—	+	—
	CYANOPHYTA				
20.	**Lyngbya* sp.	+	—	—	—
21.	**Oscillatoria* sp.	—	—	+	—
22.	**Phormidium* sp.	+	—	+	—

*Recorded for the first time; + Present; — Absent

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† Prepared by V.S.K. Chennubhotla, CMFRI, Cochin and N. Kaliaperumal, Regional Centre of CMFRI, Mandapam.

OBSERVATIONS ON THE LANDING OF LANTERN FISH *MYCTOPHUM PTEROTUM* ALCOCK ALONG MAHARASHTRA COAST*

The lantern fishes are pelagic and are considered to be deep water forms, occurring upto 2000 m depth. Though this species has been known to be abundant in off-shore regions, a fishery for it has not been reported earlier. During October–November months of 1985, one species identified as *Myctophum pterotum* Alcock (Fig. 1) was noticed to have considerable fishery value along the Maharashtra coast. Details of the landings for the period Oct.–Nov., 1985 by bag net ('dol') at a depth of 25 m are given below:

Place	Total No. of units	Total catch (kg)	C.P.U. (kg)
Sassoon Dock	75	53,005	706.7
Versova	374	26,005	69.5
Madh	128	31,590	246.8
Navgaon (Alibag)	126	52,000	412.6

The highest catch and catch/unit were registered at Sassoon Dock during this period. At this centre the fishery was of short duration. This is because of the fact that more trawlers are in operation at Sassoon Dock and fishermen land penaeid prawns of large size owing to the great demand from the exporters to feed their processing plants located at Thane (Bombay). At other centres the fishery was prolonged where more 'dol' nets are in operation and facilities are available for sun drying than at Sassoon Dock.

The length of the fishes ranged between 35 and 45 mm. Normally the species attains a size of 100 mm. The ovaries showed indications of maturing. The stomach contents of 120 specimens analysed showed that *Acetes johni* Nataraj was the main food item. Incidently *Myctophum pterotum* appeared in association with swarms of *Acetes johni* especially at Versova and Sassoon Dock. This is indicative of its preference to *Acetes* as food and unusual landings are related to good catches of *Acetes* at the centres of observation. The only other food item in the stomachs of this fish was fish scales which formed only a very small percentage.

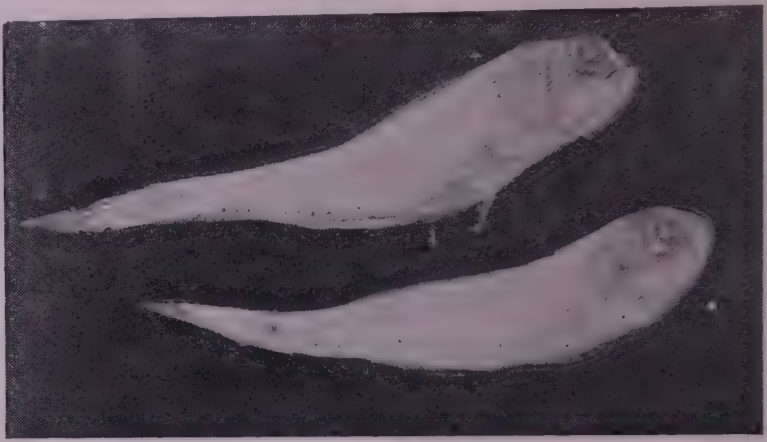
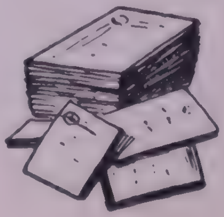


Fig. 1. Close-up view of *Myctophum pterotum* Alcock showing the luminous organs.

The fishery potential of myctophids has been reported to be considerable, though not in Indian waters. The myctophid *Diaphus dumerilii* contributed to 15 tonnes in a single haul off Uruguan coast of South America. It is possible that a tappable resource exists in Indian waters also as evidenced by the present report of heavy landings of *Myctophum pterotum*. Studies conducted in Soviet Union have established that myctophids are suitable for human consumption. It may therefore augment the much needed protein for the fish eating population in future. The catches were sun-dried for future consumption.

The authors are deeply thankful to Dr. P.S.B.R. James Director, Central Marine Fisheries Research Institute for encouragement in the preparation of this note. They are also thankful to Dr. K.Alagaraja, Head of Fishery Resources Assessment Division for guidance.



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*Prepared by M. Aravindakshan, K.B. Waghmare, J.P. Karbhari, C.J. Josekutty and M. Shriram, Bombay Research Centre of CMFRI, Bombay.

STATUS AND DISTRIBUTION OF ESTUARINE TURTLES IN INDIA*

Introduction

While knowledge of the status, distribution and reproductive biology of marine turtles of the Indian seas has increased considerably in recent years, the estuarine turtles have been very much neglected. Two species of turtles occur in the estuarine regions of the country, the River terrapin *Batagur baska* (Emydidae: Batagurinae) and the Asian giant softshell turtle *Pelochelys bibroni* (Trionychidae: Trionychinae), both species extending their distribution further east into southeast Asia. The present article reviews the status and distribution of these two estuarine turtles.

Batagur baska (Gray) (River terrapin)

A large emydid turtle, with shell length exceeding 60 cm; snout–tip tilted, saw–jawed; carapace smooth and heavily buttressed; four claws on each forelimb. The species exhibits seasonal and sexual dichromatism. Breeding males from Burma have been described as having pale blue nostrils, intense black head and crimson neck and forelimbs. In Malaysia, the skin and shell of breeding males turn jet black, while at other times it is brown or grey. Females and juveniles paler in colour.

The species generally inhabits estuaries of large rivers and freshwater lakes, and canals in their vicinity and coasts near river mouths. In India, the River terrapin is confined to the Sunderabans of West Bengal, and has a small population which is endangered. Extralimital distribution and estimated population sizes are as follows: Bangladesh–indeterminate; Burma–minor; Thailand–minor; Malaysia–major; Indonesia–minor and Indochina–indeterminate.

Listed as 'endangered' by the IUCN Red Data Book, primarily because of overexploitation of eggs and adults for food and habitat destruction (Groombridge, *The IUCN Amphibia - Reptilia, Red Data Book, Part I, Testudines, Crocodylia and Rhynchocephalia.* IUCN, Gland, 1982), and under Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), indicating that nternational trade in the species is prohibited.

Distribution in India

In the tidal rivers, channels, creeks and sea coasts of the Sunderbans of West Bengal. Nesting takes place on deserted sandy beaches and sandspits at Mechua, Kedo and Nagbarachar. Reported also from Kanak, the 1.5 sq km sandspit (washed away by floods in 1984) situated at the mouth of the Matla River.

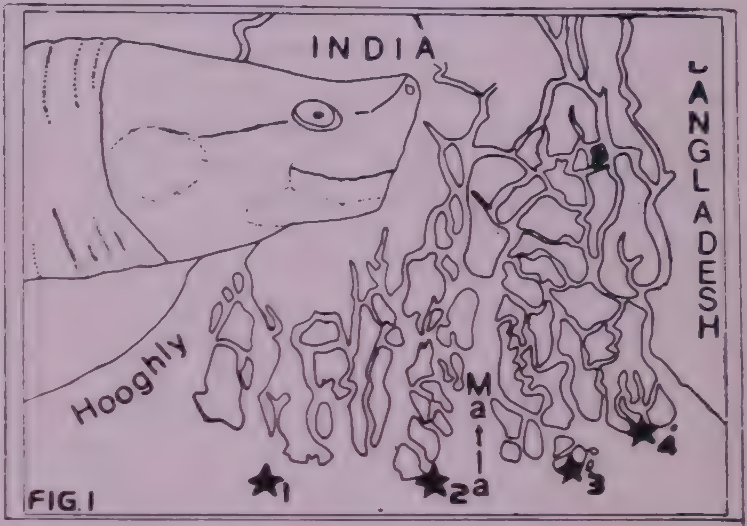

FIG.1

Fig. 1. Distribution of nesting beaches of the river Terrapin (*Batagur baska*) in the Sunderbans, West Bengal. References: 1. In Nagbarachar, 2. Kanak, 3. Kedo, 4. Mechua. Some sites determined from interviews with fishermen need to be confirmed. The small dot shows the locality of Kumirmari villages, where the species is kept as pets by villagers.

Several specimens, some trapped in nets, others hatched from eggs are being kept as pets in village ponds at Kumirmari and elsewhere north of the Sunderbans Tiger Reserve. The species is caught in offshore nets for sale along with Olive ridley *Lepidochelys olivacea,* during the winter months, from the vicinity of Sagar Island, in the western Indian Sunderabans.

Conservation measures proposed

Inclusion of species in Schedule I of the Indian Wildlife (Protection) Act, as it is endangered; enforcing existing legislation and thereby preventing capture of adult terrapins and collection of egg from the Tiger Reserve area; identifying nesting grounds which may exist outside the Reserve and extending protection to these; public education; setting up a breeding programme, perhaps using only the captive stock available as it causes no further capture from the wild population and continued research on the status and ecology of the species.

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*Prepared by Indraneil Das, Department of Limnology, Bhopal University, Bhopal.

Pelochelys bibroni (Owen) (Asian giant softshell turtle)

The largest softshell turtle in the world, known to attain 168 cm in shell length and 250 kg weight. Head small and broad, snout short, rounded; eyes situated close to the nostrils; dorsally olive, dotted with yellow; ventrally whitish.

The species is known from estuaries and sea coasts in the country but the population seems to be small. Outside, it has also been documented from inland waters, like rivers and streams. Extralimitally in Burma, China (Foochow, Canton, Kwangtung and Hainan), Indonesia, Malaysia, New Guinea, Philippines, Thailand and Viet Nam. Precise information on status in much of its extensive range is unavailable, the species being caught for food in a number of countries. It has been reported from Bangladesh.

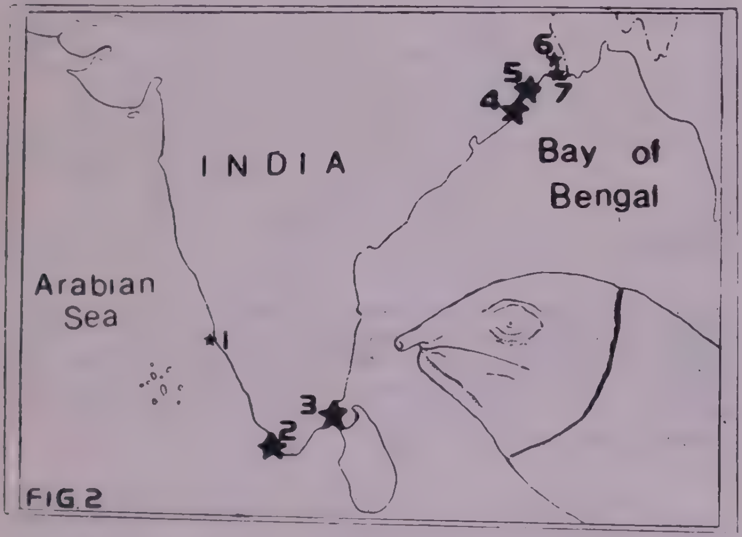

Fig. 2. Distribution of the Asian giant softshell turtle *(Pelochelys bibroni)* in India. Large stars refer to reliable records mentioned in the text; small stars refer to records of unknown reliability. References: 1. Mahe, Pondicherry, 2. Trivandrum, Kerala, 3. Vicinity of Mandapam, Palk Bay, Tamil Nadu, 4. Gahirmatha, Orissa, 5. Udaipur village, Subarnarekha river Orissa, 6. Calcutta, Hooghly river, West Bengal, 7. Sunderbans, West Bengal.

Unlisted by the IUCN Red Data Book or under the Appendices of the Convention on International Trade in Endangered Species of Wild Fauna and Flora.

Distribution in India

Known from a few localities both on the east and west coasts of India. The east coast sites include the Brahmini–Baitarini delta at Bhitar Kanika Wildlife Sanctuary, Orissa, where the species is reported to nest, Subarnarekha River at Udaipur village, Orissa, near the West Bengal border and the vicinity of Mandapam, in the Palk Bay. Smith *(Fauna of British India including Ceylon and Burma. Reptilla and Amphibia. Vol. I. Lonicata, Testudines.* Taylor and Francis, London, 1931) questioned its occurrence in Bengal, but, the turtle is recorded from Bangladesh, once a part of Bengal. There is a single record from West Bengal (collection of the Zoological Survey of India, Calcutta, Reg. No. 1781), by the naturalist John Anderson in the nineteenth century, labelled 'Hughli R. Calcutta'.

The only confirmed record of the Asian giant softshell turtle from the west coast of India is from Trivandrum beach, Kerala. However, there is a view that this could be *Gymnopus indicus* (Syn. *Chitra indica*) whose estuarine habits are well documented.

Conservation measures proposed

Inclusion of the species in Schedule I of the Indian Wildlife (Protection) Act, as it is rare and localised in the country (presently it is under Schedule IV); public education in localities where it is captured for food; survey of areas where the species is likely to occur and their subsequent protection and further research on the status and ecology of the turtle.

Acknowledgements

Research on the turtles of the Sunderbans of India was supported by a grant from the World Wildlife Fund, India. The author wishes to acknowledge the encouragement and advice received from Dr. Edward O.Moll, IUCN/SSC Freshwater Chelonian Specialist Group and Ms. Bonani Kakkar, Project/Education Officer, WWF, India (Eastern Region). Logistical support was provided by the West Bengal Forest Department.

NEW ALL-WEATHER FISHERY HARBOUR FOR VERAVAL*

Veraval forms one of the major fish landing centres of the Saurashtra coast with fish landing ranging from 59,930 tonnes in 1984–'85 to 42,535 tonnes in 1985–'86. The commercial trawling by private entrepreneurs started only in 1967 and since then there has been a steep increase in the number of trawlers and other boats. There are about 511 trawlers, 120 OBM boats, 45 IBM boats and 20 non-mechanised boats in Veraval. Such a situation has necessitated the construction of a full fledged fishery harbour comprising a landing quay, berthing basin, an out fitting quay for replenishing fuel, water and other accessories and a slipway or dry dock for repairs to cope up with the increasing fishing vessels as well as the catches.

Realising this fact, the Government of India in the IInd Five Year Plan period together with the UNDP as an executing and participating agency of the FAO, jointly planned a Pre-Investment Survey of Fisheries Harbours Project (PISFHP).

The PISFHP which started its functions in 1968 from Bangalore, conducted a pre-investment survey in Veraval in the year 1974, during which time, Veraval had 465 vessels of various sizes.

The all-weather fishery harbour plan was approved and the World Bank sanctioned Rs. 342 million for constructing one each at Veraval and Mangrol.

In Veraval the execution of the project was initiated in the year 1977–'78 by the Fisheries Terminus Division (FTD) of the Department of Fisheries. About Rs. 300 million has been already spent, out of which Rs. 190 million alone is spent in Veraval. The fishery harbour is nearing completion. The general lay out of the harbour and the facilities being provided are as follows.

1. All-weather entrance channel protected by breakwaters. The length of main break water is about 375 m and that of secondary one is about 480 m (Fig. 1).
2. Protected basin for berthing the vessels throughout the year.
3. Landing quay of about 788 m for landing fishes (Figs. 2, 3)
4. Five finger jetties of 500 m length and quay of 272 m for idle berthing of boats (Fig. 4).

The harbour has also got facilities for repair. These include:

1. Slipway workshop in which boats are lifted by a moving crane and placed in the repair yard.
2. Sloping yard and minor repair facilities such as berthing facilities of 465 m, repair yard of 75,000 sq m and concrete apron of 2,500 sq m.
3. Net repair area of 1,494 sq m in three gear shades.

However, the harbour still requires a fitting-out jetty for fixing and removing engines along with service workshop facilities.

The other important facilities available in the new fishery harbour are given in Table 1.

Table 1. *Auction hall and other facilities available at Veraval Fishery Harbour*

Facilities	Area and location	Number/area/production capacity
1. Auction hall	100 x 25 m	3 (7,500 sq m)
2. Packing room	4 x 5 m	45 (900 sq m)
3. Ice plant	i) Near landing quay – Auction hall	3 (production:48 t) storage:125 t)
	ii) Near out fitting jetty or quay	2 (production:40 t) storage: 155 t)
4. Cold storage	i) Chilled –near landing quay	3 (cap. 800 t)
	ii) Frozen - near out fitting jetty	1 (cap. 100 t)

The harbour has also got facility for parking all types of vehicles and has an area of 2,800 sq.m. The infrastructure facilities such as roads, electricity, water supply and drainage are also provided.

Although these facilities do exist, there are a few more, which are yet to be developed. For example, storing facilities for fishing gears, fish processing area, areas for ancillary industries like net making, and a shopping complex for providing requirements for fishermen who go on voyages are a few among them.

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*Prepared by A.P. Lipton and S.G. Raje, Veraval Research Centre of CMFRI, Veraval. The help rendered by Shri Vasavada, Director, F.T.D. Veraval in the preparation of this note is gratefully acknowledged.

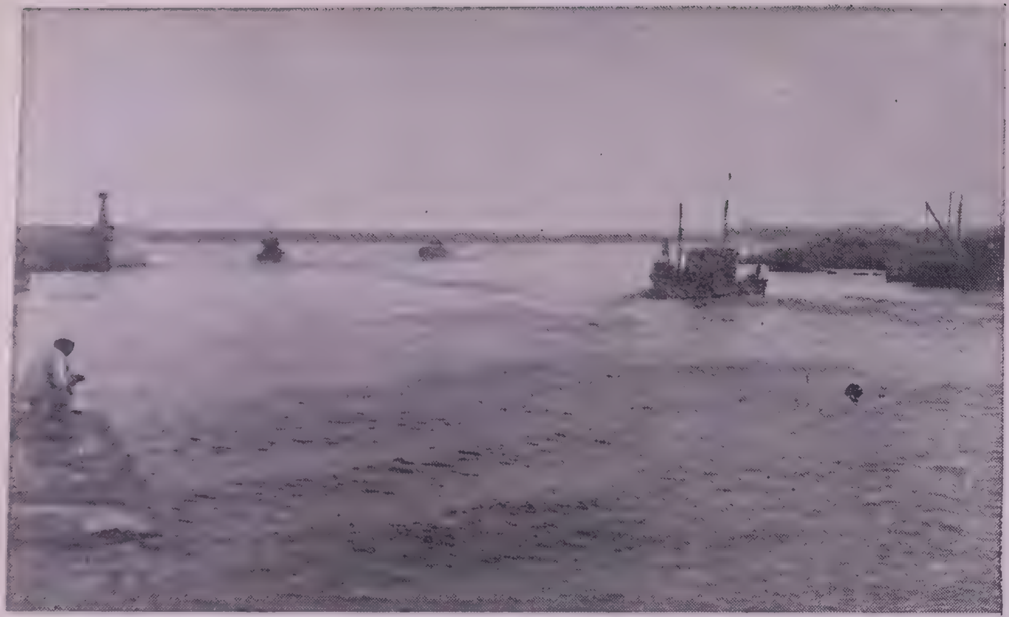

Fig. 1. Entrance channel.

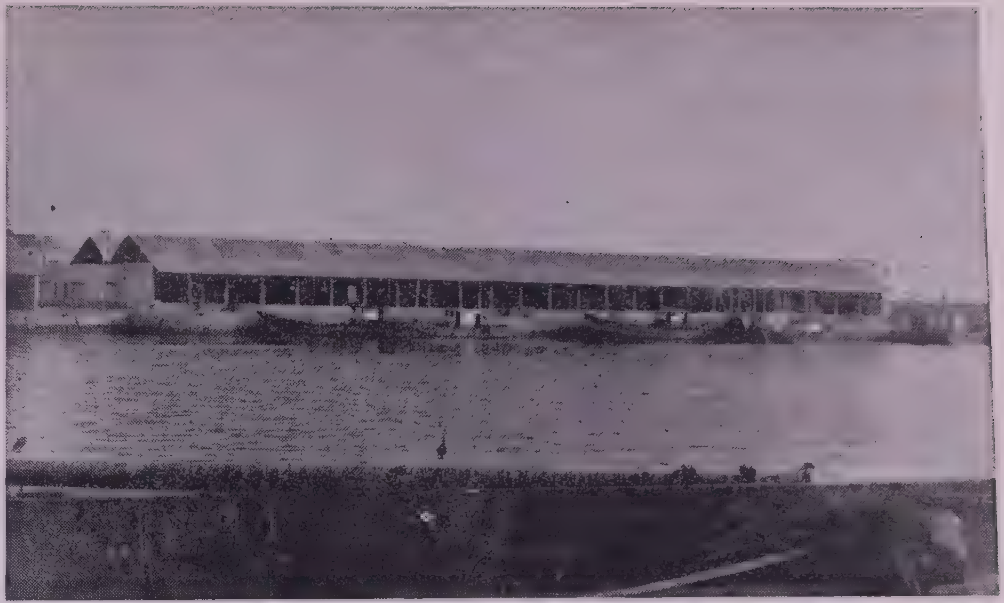

Fig. 2. Landing quay.

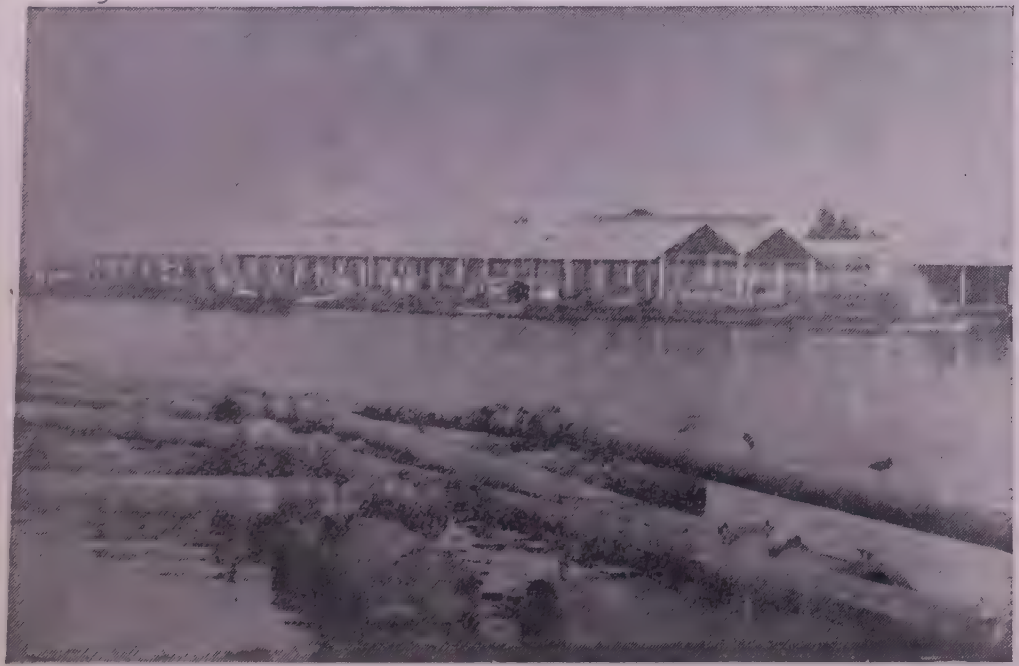

Fig. 3. Landing quay for trash fishes.

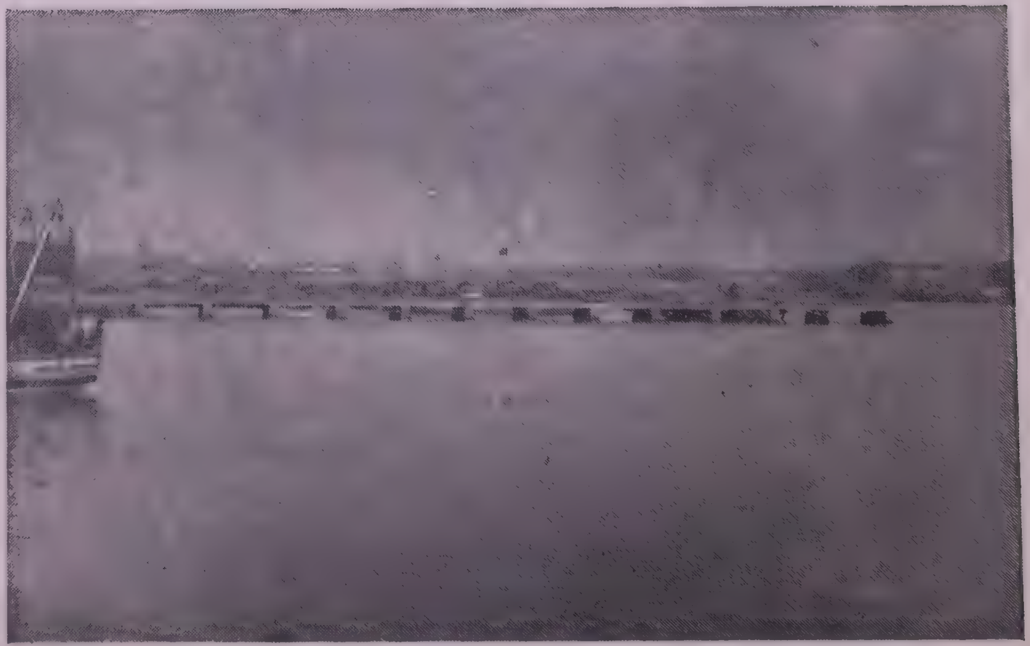

Fig. 4. Finger Jetty.

The fish auction facilities are owned and operated by the FTD. The FTD also regulates the route of vessels. The incoming vessels should come along side in front of the auction hall, unload the catch except the trash fish on to the quay and then proceed to the auction hall and to the merchant booths. The vessels then proceed to the quay in front of the trash fish platform where the trash fish will be unloaded and there after the vessels proceed to the out fishing quay where facilities for deck washing, fueling, supply of provisions, potable water, and fishing gear are provided. Then the vessels could berth along the side of berthing quay in readiness for the next fishing trip.

Good quantities of trash fish are landed in Veraval and it is suggested to have more fish meal plants. At present only one plant is available. Insulated bogies in train may be of great use in transporting quality fish to out stations. Similarly insulated vans like 'Cold-chain' as available in Karnataka state can also be introduced to supply fishes to far off interior places in the state. The drainage of Veraval Municipality at present is allowed to fall in the fishery harbour which may be diverted to some other location.

NEWS

SYMPOSIUM ON TROPICAL MARINE LIVING RESOURCES

The Marine Biological Association of India, Cochin announces its proposal to conduct a Symposium on Tropical Marine Living Resources – their Ecology, Stock, Exploitation, Utilization, Conservation and Management from 12–16 January, 1988 at Cochin, India. The main objective of the Symposium is to promote research, development and management of the tropical marine living resources as a multi-disciplinary science, by involving scientists, technicians, extension workers, administrators, planners, farmers and industrialists.

The Symposium will consider all scientific and technical aspects of tropical marine living resources, their management and development. Towards this endeavour, the sponsoring agency invities:

- regional/country review papers on the present status of tropical marine living resources investigations including exploitation, utilization, conservation and management.

- experience papers on:

* population characteristics and stock assessment of the marine living resources
* environmental impact on resource characteristics
* exploitation and capture technology
* fishery technology, marketing and trade
* bio-active agents from marine living resources
* fishery economics and sociology
* education and man-power training
* legal aspects of exploitation, extension and co-ordination
* planning, conservation and management.

Intending participants are required to pre-register their names by sending particulars in prescribed form so as to reach the General Convener of the Symposium on or before 30th September, 1987. The abstract (s) of paper (s) in duplicate may be sent to the General Convener before the above date.

For further details contact:

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MERCURY

MARINE FISHERIES INFORMATION SERVICE

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Technical and Extension Series

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

COCHIN, INDIA

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

THE MARINE FISHERIES INFORMATION SERVICE: Technical and Extension Series envisages the rapid dissemination of information on marine and brackish water fishery resources and allied data available with the National Marine Living Resources Data Centre (NMLRDC) and the Research Divisions of the Institute, results of proven researches for transfer of technology to the fish farmers and industry and of other relevant information needed for Research and Development efforts in the marine fisheries sector.

Abbreviation – *Mar. Fish. Infor. Serv., T & E Ser.*, No. 73: 1987

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4. Bombay duck landings by trawlers at Sassoon Dock, Bombay during 1983–'84
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Front cover photo:

Reclamation of shrimp nursery areas in progress at Cochin

Back cover photo:

Another view of extensive reclamation in Cochin backwaters

IMPACT OF ENVIRONMENTAL CHANGES AND HUMAN INTERFERENCE ON THE PRAWN FISHERY RESOURCES

C. Suseelan
Central Marine Fisheries Research Institute, Cochin

Introduction

Although the marine prawn production of India has shown phenomenal increase over the past two decades, year to year fluctuations in the landings are a common feature noticed during the last few years. Many possible reasons have been attributed to this and the general conclusion is that the unsteady nature of production, in several areas, is due to fishery independent factors. Depletion of stock due to overfishing has also been suspected in some of the heavily exploited areas of the west coast. In this context it is worthwhile to examine the impact of various changes occurring in the environment and human interference (other than fishing) on the natural stock of prawns so that necessary protective measures could be taken to ensure sustainable yield.

It is a well established fact that the commercial prawn fishery of our waters is dependent on two distinct environments having different ecological features, *viz.* the sea and the estuaries. The adults of these prawns breed in the sea and the postlarvae migrate into estuaries and backwaters where they grow fast and return to the sea on reaching adulthood. The important species occurring in the marine as well as estuarine environments are *Metapenaeus dobsoni, M. affinis, M. monoceros, M. brevicornis, Penaeus indicus, P. monodon, P. semisulcatus* and *P. merguiensis.* The giant freshwater prawn *Macrobrachium rosenbergii* and a few other species of the same genus utilise the brackishwater areas for breeding purpose.

The major brackishwater systems of India include the estuaries of river Ganga, Mahanadi, Godavari, Krishna, Cauvery, Narmada and Tapti and the lakes such as Chilka Lake, Pulicat Lake, Ashtamudi Lake and Vembanad Lake with their connected backwaters. All of them are permanently connected to the sea and are subjected to strong tidal influence and mixing of freshwater influxes. Besides these, there are innumerable small estuaries also distributed all along the west and east coasts, having perennial or seasonal connection with the sea. All these areas are good nursery grounds for many species of prawns that support commercial fisheries in the adjoining seas.

As in the case of any other aquatic organisms, the biology of prawns is closely governed by the physicochemical conditions of the environment in which they live. Due to the rapid advancement in civilisation, many kinds of changes are brought about in their habitats by natural as well as unnatural processes. The impacts of such changes on the prawn resources are enumerated below.

IMPACT OF ENVIRONMENTAL CHANGES ON THE PRAWN RESOURCES

Generally speaking, the ecological conditions of prawn's habitats in the sea are not easily affected by external influences to cause deleterious effect on these animals except in extreme cases. In the small, shallow water areas like the estuaries, on the other hand, frequent changes in the environmental parameters are quite common and they have profound influence on the life processes of the estuary-dependent species. The major factors regulating the recruitment, survival and growth of the juvenile prawns in these environments are: opening and closing of the barmouth, tidal effect, water circulation and currents, temperature, salinity and other chemical properties, turbidity, fertility, vegetation and the nature of the substratum.

Environmental changes are brought about by two different ways, *viz.* by natural causes and by human interference. The former may include physical changes in the bar openings, unpredictable weather conditions leading to heavy floods and droughts and prolific growth of undesirable aquatic weeds. The important changes brought about by the activities of man are those caused by (1) large scale reclamation, bulkheading and filling and dredging, (2) engineering works such as construction of barrages, salt-water barriers, spill-ways *etc.* and (3) water pollution caused by various factors.

Formation of sand-bars across the opening of estuaries and lakes

Formation of sand-bars across the opening of small estuaries and other coastal ecosystems is a common feature noticed along Indian coasts during the summer period. The barmouth establishes proper connection with the sea in the beginning of monsoon season as a result of the flushing of rain water into the sea and remains open till the end of that season. During the land-locked condition after the monsoon period it is natural that the movement of penaeid prawns between the two environments is totally arrested, and this could ultimately result in low production of prawns in the fishing grounds. The closure of bar mouth also brings about adverse conditions to the impounded prawns, due to stagnation of water, low oxygen, high temperature and excessive increase in the salt contents beyond the tolerance limit, on account of extreme evaporation.

Floods and droughts

Occurrence of heavy floods in the estuaries and riverfed backwaters during the monsoon period gradually reduces the distributional range of juvenile prawns in those areas. Field studies conducted by the author on the seasonal distribution of penaeid prawns in Vembanad Lake in Kerala have shown that juveniles of *Penaeus indicus* disappear from the upper reaches along with the discharge of monsoon flood and recolonise these areas again after the rainy season is over. The prawns recruited into this environment during the monsoon period fail to penetrate the interior areas due to the strong flow of freshwater and also possibly due to the very low salinity conditions brought about by this physical change.

Extreme cases of drought pose serious problems to the prawns that live in salt-water pools and shallow impoundments. Here, due to the high rate of evaporation the temperature and salinity of the water increase considerably and the prawns become exposed to conditions beyond their tolerance limit.

Prolific growth of aquatic weeds

Presence of moderate amount of vegetation is an essential factor in any aquatic environment as it increases the productivity and provides food as well as shelter for many organisms including prawns. However, excessive growth and accumulation of undesirable weeds in the water can have harmful effects as well, since they reduce the tidal effect, light penetration and photosynthetic oxygen production in the ecosystem. A typical example of this phenomenon is the infestation of the African weed *Salvenia auriculata* in the fresh and brackishwater areas of Kerala. This exotic weed multiplies enormously in the freshwater systems and are transported to the backwaters and lagoons during the monsoon season. In the postmonsoon period when the river flow is low, tidal water carries large quantities of the weed upstream, building up stagnant blankets over the backwaters where they undergo decay due to salinity and get deposited at the bottom. Besides being a hindrance to various aquatic activities, this plant is a biological menace as it depletes the oxygen and nitrates in the water column and changes the nature of the bottom by depositing decayed parts. The depletion of oxygen occurs by different ways such as (1) formation of the thick mat-like covering on the water surface preventing mixing of atmospheric oxygen with water and light penetration thereby affecting photosynthesis of algae and diatoms and (2) decaying of the dead plants at the bottom. This can make the affected areas unsuitable for the growth of young prawns.

Land reclamation, bulkheading and filling and dredging activities

One of the major changes now taking place in many parts of the brackishwater systems of our country is the large-scale reclamation of water areas for agriculture, aquaculture and other purposes. While some of these activities are in connection with the various developmental schemes of the Government, like the few that could be seen progressing in Cochin backwaters at present, many are undertaken by private parties, either legally or illegally, without any control. These activities not only reduce the total acreage of the shrimp nursery grounds but also considerably alter the physical features like tidal flow, water circulation and current, which in normal cases together act and make the environment congenial for the prawns. Similarly, bulkheading and filling of shorelines and shallow salt-water areas undertaken as part of the water front development programmes in urban coastal areas also have their bad effects if carried out in an unplanned manner. This is particularly a problem which has relevance to the postlarval and early juvenile prawns that inhabit mostly the surf-beaten submerged sea-shores and shallow marginal areas of the backwaters.

Various dredging activities associated with clearing of navigational channels, mining of mineral resources like fossil shell deposits, and filling process are quite common in the marine and estuarine areas inhabited by prawns. Dredging in shorelines is most destructive of marine habitats. Prawns being bottom dwellers, feeding on the rich organic substances available at the bottom, are affected by the depletion of biological productivity due to increased silt load and turbidity in the areas disturbed by dredging.

Construction of barrages, salt-water barriers and spillways

The most important among the various activities of man which cause changes in the natural habitat of prawns are the construction of engineering structures on river basins and estuaries, such as barrages, saltwater barriers, stream diversion spillways and tide control structures. These projects may alter the entire physico-chemical conditions of the ecosystems, particularly of estuaries and backwaters, and reduce the nursery areas of prawns by restricting the influx of sea water. This results in impeded exchanges of fresh and saltwater, loss of tidal exchange benefits, change in water circulation pattern affecting the distribution of salinity, temperature, *etc.* and lessening of average depth. Salinity being the most affected parameter in these cases, the pattern and extent of its variation modify the distribution of juvenile penaeid prawns as well as the estuary-dependent breeding population of palaemonids.

The Thanneermukkom Bund Project of Vembanad Lake in Kerala is an ideal example for such barriers put in the natural brackishwater environments, which have considerably influenced the prawn resources. This bund was constructed in 1976 to prevent saline water from the sea entering the extensive paddy fields of Kuttanad area in Central Kerala. While this has considerably helped to augment the paddy production of the State, it has also brought in a number of problems concerning the natural resources of the lake and the socio-economic condition of the people inhabiting that area. Since the tidal flow was completely arrested by the bund and the salinity reduced to almost zero level, the penaeid prawns became very scarce in the lake beyond Thanneermukkom. Experimental try–net fishing conducted by the author on either side of the bund during the peak summer period (February–April) of 1977–'79 yielded only less than 5 prawns/haul in the freshwater side as against an average of 110/haul recorded from the saltwater side. Because of the drastic reduction in the abundance of penaeid prawns beyond the bund, all the stake nets and dip nets used for catching the prawns in that area had to be removed after closure of the shutters in 1976. In the saltwater side also the prawn production in the areas nearer to the bund has considerably declined due to the reduced tidal effect and therefore most of the fishermen engaged in prawn fishing there have now taken up other avocations.

Water pollution

Aquatic pollution is a serious and growing threat to the living resources of our waters and also to human health. Although the extent of biological effects of pollution on the animals living in large water-bodies like the ocean are not fully understood, there is increasing evidence to believe that it can cause havoc to those occurring in estuaries and other nursery areas which are more prone to pollution than the sea. Some of the possible effects of aquatic pollution on animals including prawns are: (1) large-scale mortality, (2) reduced rate of growth and survival, (3) retarded maturation and inhibition of spawning, (4) reduced rate of egg production, (5) uptake and accumulation of toxic substances and other pollutants making the animal unfit for human consumption and (6) reduced quality and export value of the product.

The marine and brackishwater environments constantly receive several kinds of pollutants, directly or indirectly. While some of the pollutants are leached out from the land and carried by rivers to the estuaries and coastal waters, others are deliberately introduced by man. Some are also transported by the atmosphere and ultimately washed down by rain. The important pollutants that reach these environments are: pesticides, various types of industrial effluents containing heavy metals and toxic chemicals, municipal and domestic sewages, oils and oil dispersants, heated water and radio-active wastes. To some extent pollution of water also occurs as a result of large-scale retting of coconut husks and other materials in stagnant backwater areas.

Large quantities of pesticides like DDT and its derivatives used for agricultural and public health purposes find their way into the estuaries and coastal waters. While the concentration of these pesticides in the open waters are lowered by dilution, in areas with reduced circulation, mortality of animals occur at all levels. Crustaceans are particularly sensitive to these chemicals which in concentration as low as 0.003 ppm have often been found to be lethal to shrimps. Fishes and shellfishes containing high concentration of DDT (above 5 ppm) are considered to be unfit for human consumption.

Industrial effluents containing a number of inorganic wastes such as acids, alkalies, ammonia, mercury, chromium, copper, lead, arsenic *etc.* and several synthetic organic compounds, detergents and organic wastes are periodically discharged into the water, which are potentially harmful to aquatic life. Although fish and crustaceans can detect concentration of acids and alkalies much below the toxic level and thus avoid areas of contamination, higher doses can corrode their gills affecting respiration and eventually leading to death. Consumption of fish and shellfish having high concentration of mercury (methyl mercury) has been reported to have caused dangerous diseases among people in Japan and other countries. In Sweden, fishes with more than 1 ppm mercury are considered to be unfit for human use. Many synthetic organic compounds like polychlorinated biphenyls (PCB), chlorinated hydrocarbons and organophosphorus are highly toxic to fishes, prawns and various planktonic organisms and therefore leaching of these compounds into estuaries and inshore waters is detrimental to the ecosystem. Contamination with organic wastes discharged from the paper factories, seafood processing units *etc.* can interfere at various trophic levels in the food chain by increasing the Biological Oxygen Demand and consequent depletion of oxygen in the water, which ultimately lead to reduction in the fishery resources.

Dissolved and suspended organic constituents of the municipal and domestic sewage could increase the productivity of the environment, but when accumulated excessively they cause oxygen depletion and other unfavourable conditions to aquatic life. They are also known to harbour many pathogenic bacteria and viruses, and human life may be endangered by eating the prawns contaminated with them. There have been several reports of outbreak of hepatitis, polio, cholera and other enteric diseases by eating shellfish contaminated with these pathogens.

Oil pollution of marine and estuarine environments can occur from various sources such as accidental spills from tankers and offshore wells, nearshore ship operations, urban and industrial sewage effluents and also through the atmosphere. When oil is released into the water, the lighter fractions evaporate and with the residues a water-in-oil emulsion is formed over the surface. In the sea, this spreads to extensive areas by wind, waves and tides and gradually reaches the beach. A film of oil on the water surface acts as a barrier to exchange between water and atmosphere. This reduces the dissolved oxygen content in the water which affects the planktonic larvae. Direct contact of oil with the respiratory organs weakens or kills the animals. The oil, polluting the shores may damage the small juvenile prawns by smothering them and cutting off respiratory exchange and by interfering with their movement and ability to withstand wave action. Oil is also known to affect the hormone system responsible for the reproduction and behaviour of larger crustaceans like lobsters and crayfishes. The oil spill in the Lakshadweep Sea from the American oil tanker 'TRANSHURON' is reported to have caused serious damages to living organisms in the polluted zone. Due to the formation of thick layers of oil in the lagoon and the wide spread deposit of tar-like paste along the beaches and intertidal areas of Kiltan Atoll, mass mortality occurred among planktonic organisms and benthic animals including lobsters and crabs. Considerable depletion in the population of planktonic decapods has also been reported from the Madras coast as a result of oil spills occurring during transport of oils and from ocean liners, tugs and mechanised fishing vessels.

Thermal effluents discharged from power plants and other shore-based industries may cause serious environmental stress in shallow estuaries and backwaters. The added temperature brings about local increase in salinity which in turn reduces the oxygen content in the ecosystem. Rise in temperature can also intensify the toxicity of other pollutants and increase the susceptibility of prawns to diseases.

Radioactive wastes dumped into the ocean are potentially very dangerous to the marine organisms. Prawns being bottom dwellers feeding on suspended detritus, are likely to ingest radioactive substances also along with the food, and they may get concentrated in the body tissue. These substances are highly mutagenic and carcinogenic and can also affect human beings indirectly.

The various types of pollution discussed above will have far reaching effect on the prawn fishery resources of our waters. Due to the rapid technological advancement and urbanisation most of the nursery areas of commercially important prawns get badly polluted. The Hooghly Estuary down stream from Calcutta receives the wastes from about a hundred industries. Other polluted coastal areas are near Bombay, Trivandrum and the outlets of the rivers Krishna, Godavari, Cooum and Chaliyar. The effluents from the industrial complex at Alwaye and nearby areas poured into the Periyar River flow through the backwaters enroute to the Arabian Sea and pose serious threat to the fish and prawn population of the estuary and inshore waters of the Kerala coast. Large scale mortality of fishes and other organisms due to the contamination of industrial effluents has been reported from Cochin backwaters, Chaliyar river and other estuarine systems.

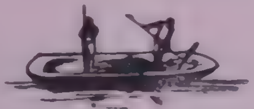
IMPACT OF LARGE-SCALE CAPTURE OF PRAWN FRY FOR FARMING

In recent years prawn culture has been receiving increasing importance all over the country for augmenting production for export purpose. One of the major requirements for undertaking large-scale farming is the availability of the seed of desired species. Presently this problem is solved by capturing the post-larvae and small juveniles from the surf, estuarine and backwater regions. These small fry (measuring upto about 40 mm) are collected by using velon screen drag nets and a number of other devices from the shallow nearshore areas where they mostly concentrate. In these areas the young ones of several species of prawns contributing to our commercial fisheries occur in different compositions. Since the prawn farming is mainly aimed at culturing large growing species like *P. indicus* and *P. monodon*, millions of young ones of smaller species belonging to the genus *Metapenaeus* obtained in the seed collections are often discarded. Apart from the fact that uncontrolled exploitation of the young ones from their natural nursery areas itself is a destructive process, as it can adversely affect the fishery of adult prawns, the heavy damage caused to the smaller species incidental to the procurement of larger ones is a problem that deserves more concern in the context of conservation of the resource. Since large scale exploitation of prawn fry from the wild for farming purpose is only of recent origin, the extent of its impact on the capture fisheries is yet to be evaluated.

Conclusion

It is evident from the foregoing account that apart from the usual changes associated with the commercial fishing activities, the prawn resources of our coastal waters are faced with several problems which deserve due consideration in the context of conservation of the resource. As the prawn fishery of the marine region is largely dependent on the emigrating sub-adults of the adjacent brackishwater areas, the reduction in the juvenile stock brought about by the various environmental and external influences will have serious impact on the coastal fishery. When compared with the sea, the estuaries play a more prominent role in the life and survival of the prawns, but at the same time such areas are vulnerable to human alterations which ultimately lead to the deterioration of the resource.

The problem of aquatic pollution is becoming more and more acute everyday in most of the major nursery grounds and large-scale mortality of fishes and other organisms due to environmental contamination are increasingly reported. Although specific instances of mass mortality of prawns due to these changes are not reported from any of the natural environs, probably because the dead prawns remain at the bottom and do not float up like fish, the increasing tendency of many productive areas like the Cochin backwaters getting polluted by industrial effluents and other harmful substances is alarming. Oil pollution in Indian seas has reached to such an extent that the northern region of the west coast has now become one of the world's most highly contaminated parts, with petroleum hydrocarbons. The Maharashtra coast which comes under the spell of this serious situation is one of the richer prawn producing areas of the country and how far this rate of oil contamination will affect the productivity of this coast deserves attention.



AN ACCOUNT ON THE SUB-FOSSIL SHELL DEPOSITS OF KOVALAM BACKWATER*

Vast stretches of sub-fossil deposits of molluscan shells have been found excavated by the people of Padur village around the Kovalam backwater area. The shell deposit stratum extends over an area of about 2.0 x 0.5 km on the western bank of the backwater from the Kovalam bridge to Muttukadu bridge (Fig. 1), and the shell deposits are rarely found on the eastern side of the backwater.

The detection of shell deposits is done by piercing a probe (iron rod or wooden pole) pointed at one end,

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*Prepared by R. Thangavelu, K. Rangarajan and P. Poovannan, Madras Research Centre of CMFRI, Madras.

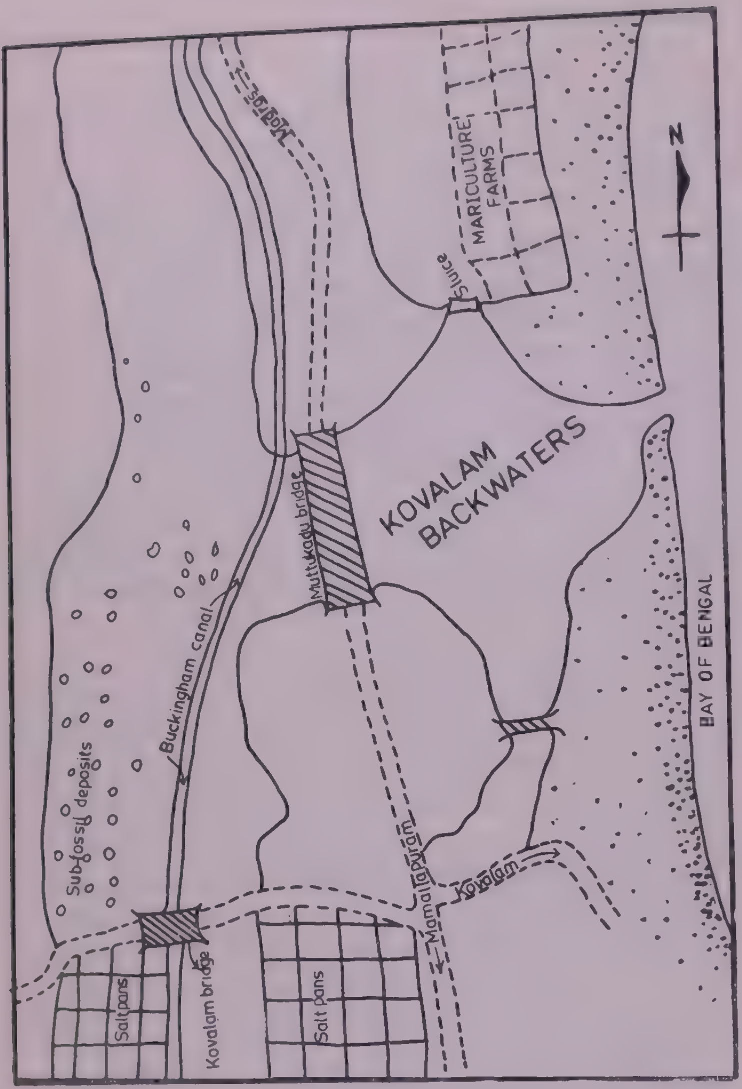
Madras
MARICULTURE FARMS
Sluice
N
KOVALAM BACKWATERS
Muttukadu bridge
Buckingham canal
BAY OF BENGAL
Sub-fossil deposits
Mamallapuram
Kovalam
Salt pans
Kovalam bridge
Salt pans

Fig. 1. Sub-fossil shell deposits of Kovalam backwater.

with a handle at the other. The dislodging of shells is usually done during the low tide. Excavation of shells is more intensive on the western side of the backwater from the bank to about 300 m width towards the water spread area than on the eastern side. Men and boys are engaged in excavation. Usually 4 or 5 persons group together and start to excavate the shells by means of spade and crow-bar (Fig. 2). The size of each pit is 2–3 m in length and 1.5–2 m in width (Fig. 3) depending upon occurrence of shells. Water percolates into the pit. After reaching the shell-strata cane baskets are used to scoop out the shells along with mud and sand. A basket lifted from the pit may contain about 50% of shells and 50% of mud. The shells in the basket are sieved to remove the sand and mud, and put in heaps (Fig 4) within easy reach of the boat. After cleaning again in the water, the baskets full of shell are carried by head-loads to the bank of the estuary by women.

From each pit about 1,000 to 1,500 kg of sub-fossil shells are obtained. Each basket of 20 kg shells is sold at Rs. 4.50 and thus each tonne of shells realises a price of about Rs. 225 in the site. One lorry load of shells costs about Rs. 700/- at Kovalam and Rs. 1,000/- at Madras including transportation costs. After baking into lime, one tonne of lime is sold for Rs. 600/- in the local market of Kovalam. The sub-fossil shells baked

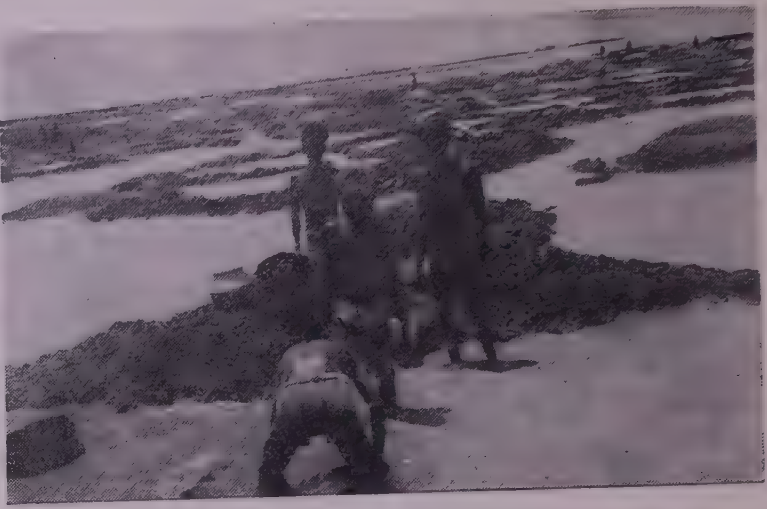

Fig. 2. Method of excavation of shells.

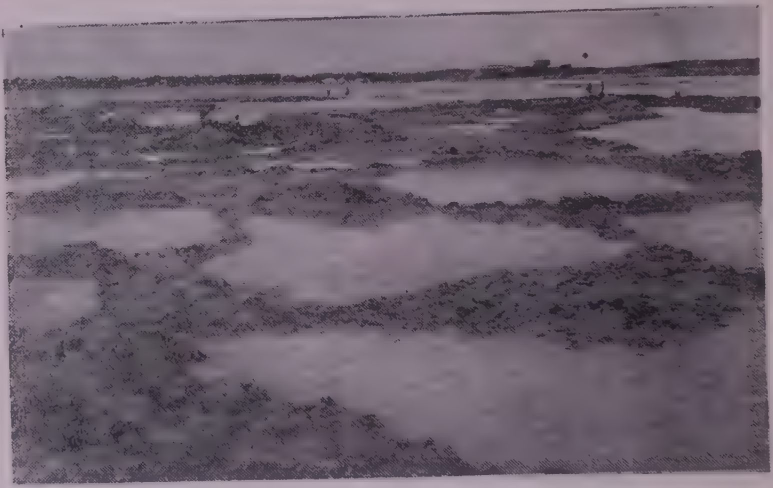

Fig. 3. Shell pits of Kovalam backwater area.

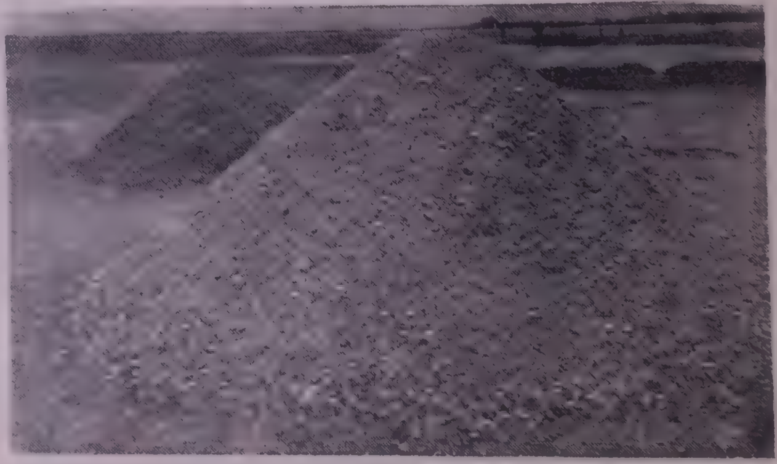

Fig. 4. Heaps of shells excavated from the pits.

into lime are used for white washing or building construction. Shells are also used for preparing poultry grit to a certain extent.

Shell deposit composition estimated from random samples of sub-fossils collected from different areas of the Kovalam backwater is given as follows:

Genera	Percentage
Cerithidium	64.24
Meretrix	15.33
Crassostrea	8.03
Umbonium	4.38
Arca	2.19
Window-pane oyster	1.46
Other gastropods	1.46
Cardium	0.72
Tellina	0.72
Miscellaneous	1.46

In almost all places of the backwater of Kovalam, the gastropod shell *Cerithidium* ranks first in the subfossils, whereas in a few places the oyster shells constitute to about 25 to 35%.

The regular season of exploitation starts during January and extend till the end of July, with seasonal fluctuations in the trend of exploitation. About 200 people from Padur village are engaged in this profession, excavating about 40 to 50 tonnes/day during the peak season March–May, and they are unemployed for most of the days during the offseason.

We are thankful to Dr. P. S. B. R. James, Director and Dr. K. Alagarswami, Joint Director, C. M. F. R. Institute for their encouragement. Thanks are due to Dr. S. Ramamurthy, Officer-in-Charge, Madras Research Centre of C. M. F. R. I., Madras for extending all facilities in preparing this report.

ON AN UNUSUAL CATCH OF BIGEYE SCAD *SELAR CRUMENOPHTHALMUS* (BLOCH) IN SHORE SEINE AT VIZHINJAM*

An unusually heavy catch of the carangid *Selar crumenophthalmus* (Bloch) was obtained close to the shore at Vizhinjam on 3rd December, 1985. The bumper catch was landed by shore seines operated on the southern side of the Inspection Bungalow of the Vizhinjam Harbour Project. This area is a short stretch of sandy beach caved into the rocky shore (Fig.1). Here fishing activities are normally scarce and one or two shore seines may be operated in a day, that too occasionally.

On 3rd December, 1985, this beach became very active and continuous operation of shore seines was noticed. In the morning of that day, some fishermen who started shore seine fishing, sighted a huge fish shoal close to the shore. The first haul itself was quite encouraging and the news immediately spread around. All the shore seine units available in the village were brought to the centre and were soon put into operation. Even before one net was completely hauled up, another was cast around the first one. Likewise 2–3 nets, one encircling the other, were in the sea at the same time. The fishing activities started at about 0800 hrs and continued till around 1900 hrs and 10 units were operated during this period at the same area.

The catch

The shore seines were operated within one kilometre from the shore (Fig. 1). The total catch was estimated to be around 33.4 tonnes caught by 10 units. The catch per effort was thus 3.34 tonnes. The catch in individual units ranged from over half a tonne to say 11 tonnes. The number of fish in each effort ranged from 3,500 to 57,100; totalling to 1,75,650 fish. The total catch by weight, number of fish in each effort, *etc.* are presented in Table 1.

The catch was exclusively of the single species of carangid *Selar crumenophthalmus* (Bloch) commonly known as Bigeye scad and locally called 'Kannan kozhiyala' (Fig. 2). Such a huge catch of bigeye scad has never been observed in this area during the past years. Also, the shoals were present in the coastal waters only for one day.

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*Prepared by P. N. Radhakrishnan Nair and N. Gopalakrishna Pillai, Vizhinjam Research Centre of CMFRI, Vizhinjam.

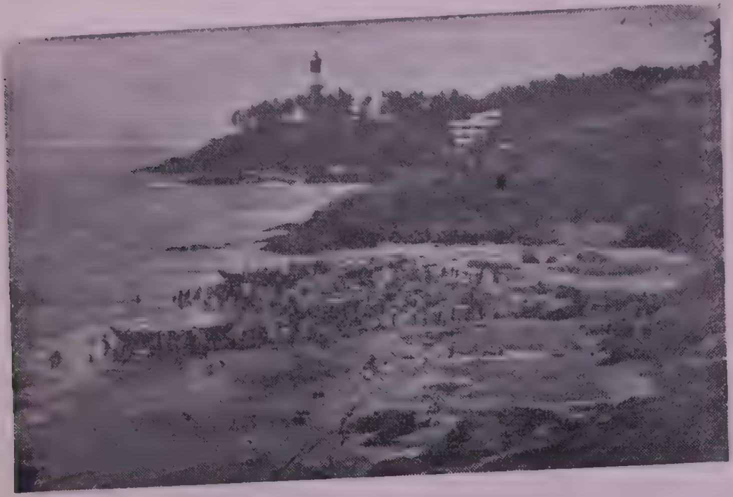

Fig. 1. A view of the landing centre and the fishing activities.

Table 1. *Total catch of* Selar crumenophthalmus *by weight* (kg) *and by number caught on* 3rd *December,* 1985 *at Vizhinjam in each unit of shore seine along with total income and price rate. (The serial number of units is not in sequence of operation)*

Gear unit	Catch by wt (kg)	Number of fish	Total income (Rs.)	Average cost per fish (Rs.)
1	4,351	22,900	22,500	0.98
2	1,414	7,440	12,100	1.63
3	1,049	5,520	5,000	0.91
4	718	3,780	5,200	1.38
5	2,048	10,780	16,000	1.48
6	994	5,230	5,000	0.96
7	665	3,500	4,700	1.34
8	6,536	34,400	34,000	0.99
9	4,750	25,000	25,000	1.00
10	10,849	57,100	55,000	0.96
Total	33,374	1,75,650	1,84,500	1.05

Biological observations

Length measurements of random samples revealed that the size of fish ranged from 210 to 300 mm in total length with an average size at 252 mm. Nearly 70% of the fish ranged between 240 and 269 mm. The major mode was located at 255 mm. Two minor modes, at 230 and 280 mm were also noticed (Fig. 3).

The fish collected for biological studies showed that the weight of individual fish ranged from 110 g for a fish measuring 210 mm to 259 g for a fish of 283 mm total length. The average weight of fish was 190 g. The length-weight relationship of the fish was analysed based on 50 fish. The length-weight formula was derived as–

$$\log W = -5.1550 + 3.0954 \log L \quad \text{or}$$
$$\overline{W} = 0.000006998\ L^{3.0954}.$$

The correlation coefficient ('r' value) was found to be $r = 0.9692$. The length-weight plot is given in Fig. 4.

Stomach content analysis of the samples showed that the percentage occurrence of stomachs in different degrees of fullness was 38% ½ full, 30% ¼ full and 32% empty. This shows that majority of the fish (62%) was in poorly fed condition. The food items were mainly pteropods (8%) and semidigested and digested matter (91%) with a few fish scales (1%).

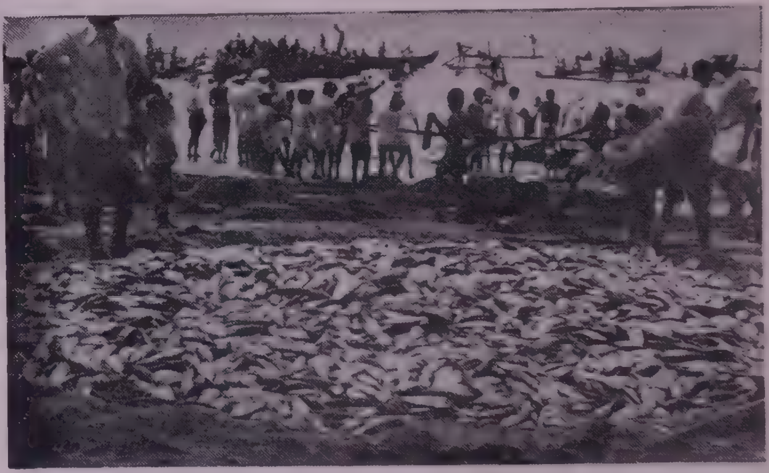

Fig. 2. A portion of the bumper catch.

In the analysis of the maturity stages of the fish examined, 6% immature, 38% resting, 52% maturing and 4% mature gonads were noticed. The sex-ratio between males and females was 46:54.

Disposal of catch

From the landing centre the fish was loaded in canoes and brought for auctioning to the main fish landing and marketing centres situated inside the Vizhinjam bay. The fish from a single unit was auctioned in different lots. The price of a single fish in a lot was fixed through open bidding and later raised to the total number of the fish in that lot. By this method of auctioning the actual count of the fish per effort could be conveniently available from the owners of the gear.

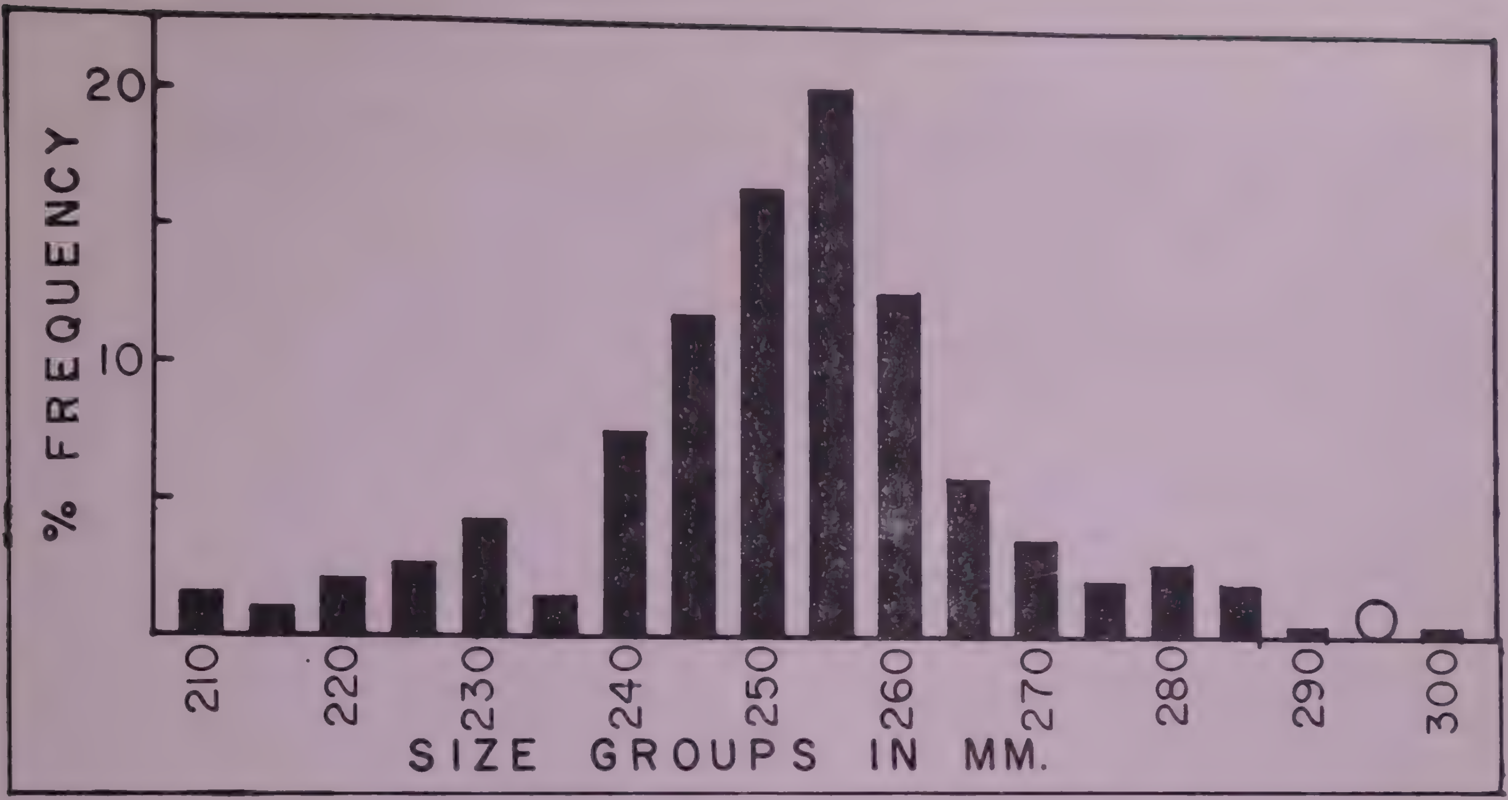

Fig. 3. The percentage size-frequency distribution of *Selar crumenophthalmus* from shore seine at Vizhinjam on 3-12-1985.

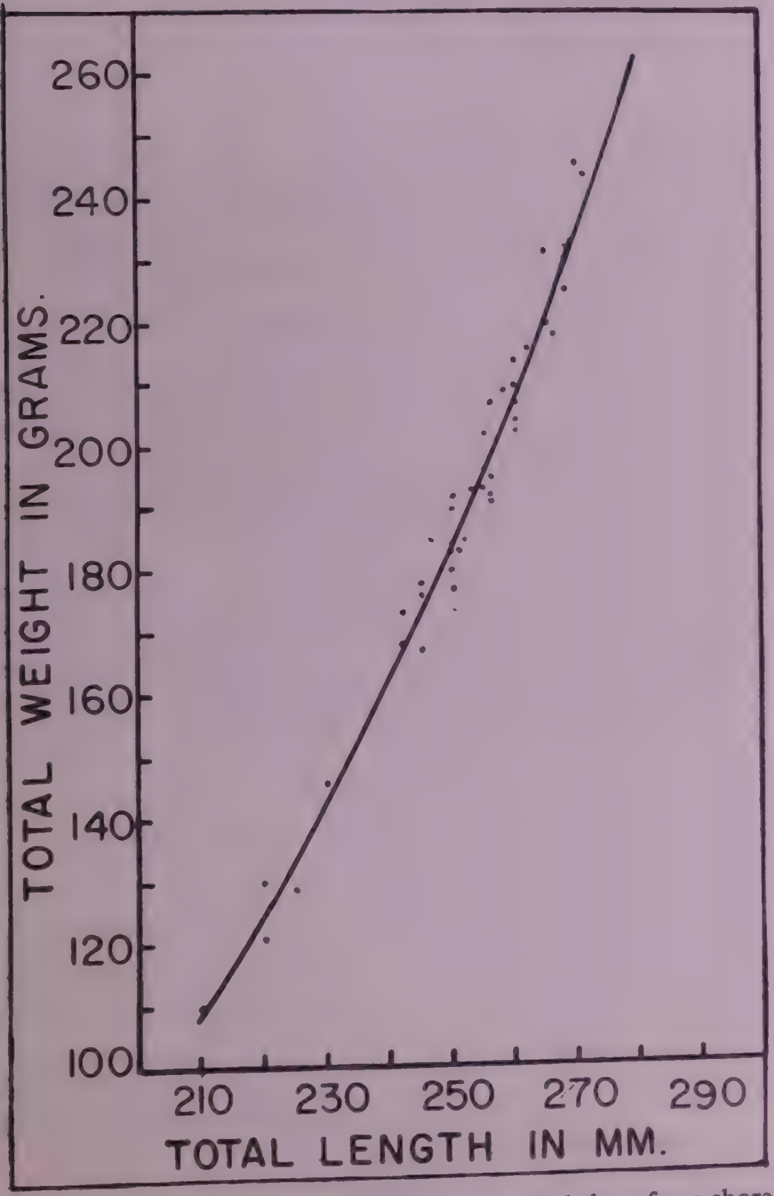

Fig. 4. Length-weight plot of *Selar crumenophthalmus* from shore seine at Vizhinjam on 3-12-1985.

From this the catch by weight was computed later. The price of a fish varied from Rs. 1.60 in the morning to Rs. 0.50 in the evening when more and more catch came ashore. The sale figures obtained later from the owners showed that the day's income from this bumper catch was around Rs. 1,84,500. From this the average price of a fish could be calculated as around Rs. 1.05 (Table 1). The fish in fresh condition was moved to the local markets by small traders, but bulk of the catch was iced and transported to the major fish markets at Trivandrum, Balaramapuram, Neyyattinkara *etc*.

Remarks

S. crumenophthalmus forms a fishery at Vizhinjam during August to March with a peak period from November to March. In some gears it has been observed in very small quantities in April to May also. In 1985-'86 the season started in June and was continuing with gaps in July and October, and the estimated catch, excluding the present bumper catch, during June to December, 1985 was 53.7 tonnes. On an average the annual contribution of this species to the total carangid catch was estimated as 5.3%.

The Bigeye scad generally does not come so close to the shore, but occasionally it reaches the inshore area in small schools and is caught in shore seines. This fish is normally caught in drift net, boat seine and hooks and line. The studies conducted at Vizhinjam since 1980, on the resources of carangids, have shown that the percentage of catch of Bigeye scad by these gears is 52.2 by drift net, 20.4 by hooks and line and 20.2

by boat seine. All these gears are normally operated at 20–30 fathom depth zone, 4–5 km away from the shore. In shore seine its percentage of catch is only 7.2. Neither the condition of the gonads nor the food of the fish sampled gave any clue for possible migration of the fish in such huge shoals into the shallow waters. Similarly, the hydrographic studies also showed that the water properties such as surface temperature (30.9°C), dissolved oxygen (4.5 ml/l), salinity (34.7‰) and pH (8.2) were only normal for the season and thus do not indicate any special circumstance for the present bumper catch.

The authors are thankful to Shri C. Mukundan, (Head of Demersal Resources Division), Vizhinjam Research Centre of Central Marine Fisheries Research Institute for critically going through the manuscript and suggesting suitable modifications.

BOMBAY DUCK LANDINGS BY TRAWLERS AT SASSOON DOCK, BOMBAY DURING 1983-'84*

The 'Bombay duck' *Harpodon nehereus* Hamilton constitutes an important fishery in the state of Maharashtra. The fishery and biology of this species have been studied. This resource is exploited mainly by 'dol', a kind of bagnet. The trawlnets are not very effective in the fishery of Bombay duck. In 1983–'84 three trawlers belonging to Fishery Survey of India namely *Meenatharangini*, *Meenapradata* and *Meenayojak* landed good quantities of Bombay duck during almost every month of their fishing operations. *Meenayojak*, however, landed the species only during September, 1983. The details of the landings are presented in Table below.

Name of the vessel	Fishing area	Depth range (m)	Catch (kg)	Percentage in total fish
Meenatharangini (200 H.P.)	18–72, 19–71, 19–72 & 17–72	27–64	2,597	14.60
Meenapradata (200 H.P.)	18–72, 19–72 & 19–71	28–68	2,307	5.07
Meenayojak (200 H.P.)	18–72	25–50	390	12.90

The gear employed in these operations was the 24 m fish trawl. The size range of Bombay duck caught in trawl net operated beyond 30 m depth was 68–380 mm. Very few mature specimens were noticed.

The appearance of Bombay duck regularly in the trawl landings is significant. It is indicative of the existence of Bombay duck populations outside the traditional operational limits of 'dol' (28 m). Larger size groups may exist in deeper regions as fully mature size groups are rarely landed by 'dol'. Absence of eggs and newly hatched larvae in the inshore plankton suggests that this species breeds in deeper waters. Presence of Bombay duck in the inshore regions and creeks such as Arnala and Marve during monsoon months may be attributed to the fact that they follow the penaeid and non-penaeid prawn population to the inshore regions, as crustaceans form a major percentage in the food of Bombay duck during the initial stages of its growth.

The authors are deeply thankful to Dr. E. G. Silas, former Director, CMFRI, Cochin for his interest in the preparation of this note.

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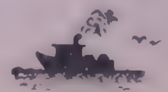
*Prepared by M. Aravindakshan and J. P. Karbhari, Bombay Research Centre of CMFRI, Bombay.



AN UNUSUAL FISHERY FOR INDIAN SCAD *DECAPTERUS RUSSELLI* AND OCCURRENCE OF INDIAN RUFF *PSENOPSIS CYANEA* AT CALICUT WITH NOTES ON BIOLOGY OF FORMER SPECIES*

Introduction

Though scads (locally known as '*chamban*') used to appear in the catches at Calicut generally after the south-west monsoon, it has not supported a sizable fishery here in the near past. But, from 19th August to 10th September, 1986, there were unusually heavy landings of scads (Fig. 1) all along the Calicut coast by boat seines, operated at depths varying from 35 to 50 metres. When the operations were at a depth of 45 metres or above, appreciable numbers of *Psenopsis cyanea* were also caught for the first time at Calicut. Detailed data collected on this fishery from Vellayil (Calicut) from 23rd August to 10th September, 1986, along with notes on some aspects of the biology of *Decapterus russelli,* the most important component of the fishery, are presented in this report.

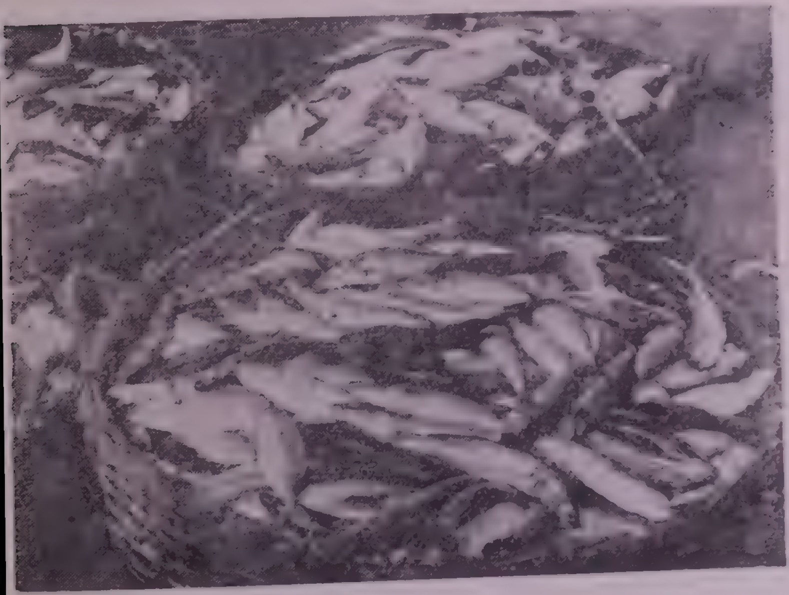


Fig. 1. A view of scads landed at Calicut.

The fishery

The gear employed in this fishery at Vellayil was a boat seine namely *Pattenkolli.* Country crafts employed were all fitted with Yamaha out board engines. The operations were at a depth of 45–50 m till 2nd September and subsequently the operations were at a depth of 36-40 m in the night hours. The units used to leave for fishing at 1830 hrs and return between 0300 and 0900 hrs.

There was hectic fishing activity (Fig. 2) and 1,589 *Pattenkolli* units were operated during this period and most of the boats landed good catches of scads (Fig. 3). Normally, this is the peak period for mackerel catches by *Pattenkolli.* But, with a staggering total catch of 1,170 tonnes of scads during this period it eclipsed the mackerel fishery which yielded only 220 tonnes. The first peak in the scad catches was observed on 24th August (Fig. 4). From 28th August to 2nd September, when operations were at greater depths, say beyond 45 m, there were good catches of *Psenopsis cyanea.* The highest peak in the scad catches was observed on 2nd September, when 178 tonnes of scads were caught with a CPUE of 1,156 kg. The total catch (in kg) of different components are given below.

Fig. 2. Hectic activity – *Pattenkolli* units landing scads.

Species	Catch	CPUE	%
D. russelli	11,16,370	702.56	68.49
D. macrosoma	54,075	34.03	3.32
P. cyanea	12,153	7.65	0.75
R. kanagurta	2,20,464	138.74	13.53
Others	2,26,803	142.73	13.91
Total	16,29,865	1,025.72	100.00

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*Prepared by T. M. Yohannan and K. K. Balasubramanian, Calicut Research Centre of CMFRI, Calicut.

D. russelli (locally known as *'kannan chamban'*) constituted 95.38% of the scad catch and *D. macrosoma* (locally known as *'kol chamban'*) 4.62%.

Fig. 3. A boat-full of scads.

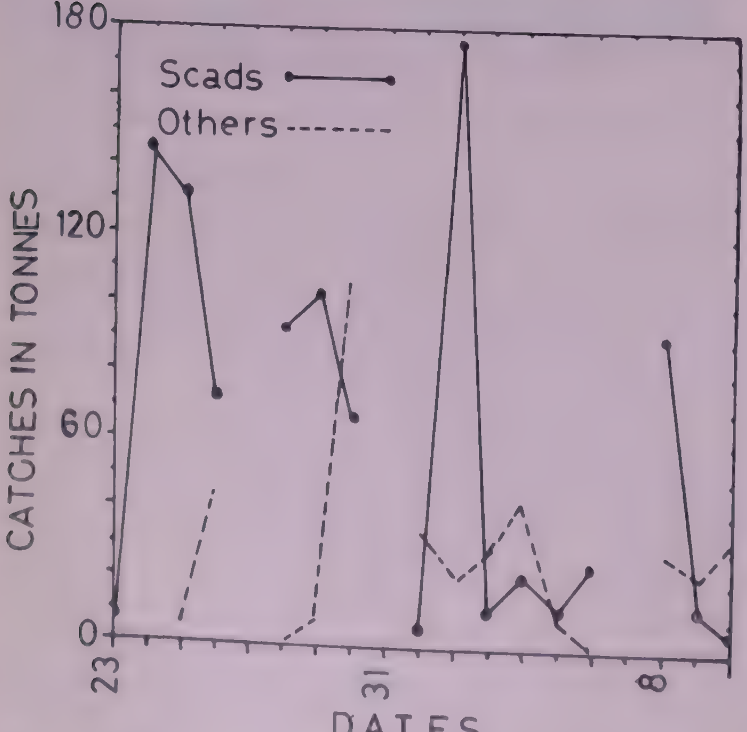

Fig. 4. Daily catches from 23rd August to 10th September, 1986.

STUDIES ON THE RESOURCES OF *D. RUSSELLI*

Size distribution

A random sample of 262 number of *D. russelli* was collected and studied in detail. The length of *D. russelli* ranged from 105 to 224 mm. The major mode was at 197 mm. There was a secondary mode at 167 mm. The smaller size groups had a mode at 122 mm (Fig. 5). Sreenivasan *(Indian J. Fish.,* **29**: 144-150, 1982) while studying the growth of *D. dayi* which is synonymous with *D. russelli* (Fischer and Bianchi, *FAO species identification sheets for fishery purposes, Western Indian Ocean* (Caron Deca 8 FAO, Rome, 1984) has observed that *D. dayi* reached a size of 150 mm (fork-length) in one year and 184 mm (fork-length) in 19 months. The present lengths are total lengths and the fork lengths measured by Srinivasan when converted to total lengths it would be 166 mm for one year and 204 mm for 19 months. Hence, it can be assumed that the modal length 122 mm represents 'O' year-class, the modal length 167 mm one-year-olds and modal length 197 mm 6 months older. 62.98% of the fishes were in size between 180 mm and 224 mm (one and a half year or older fishes), 23.66% between 150 and 179 mm (one-year-olds) and 13.36% between 105 and 139 mm ('O' year-class).

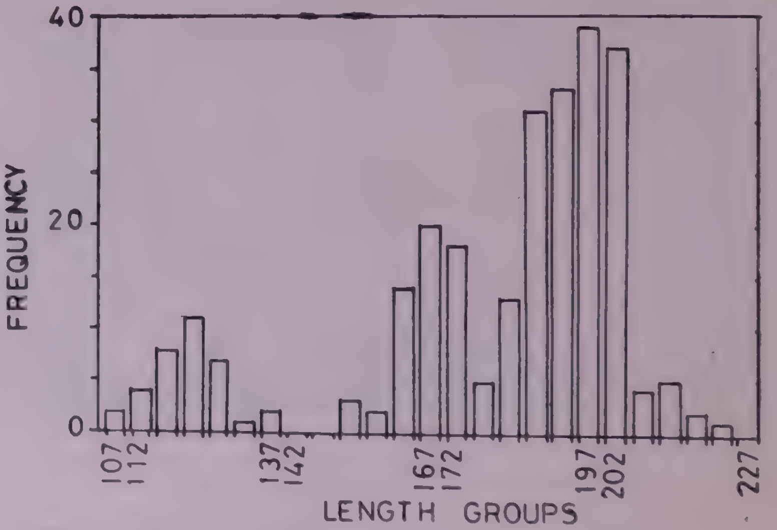

Fig. 5. Frequency of length groups in the sample (mid-points given).

Maturity

Males dominated the catches contributing about 60.71%. 70.91% of the fishes in the size range of 180–224 mm was mature and many were in running stage exuding ova or milt with a slight pressure on the abdomen. 27.59% of the fishes in the size range of 150–179 mm also were mature. Those in the size range of 105–139 mm vere all indeterminates. The percentages of mature ndividuals in different size groups of 10 mm interval re shown in Fig. 6 (mid-points 165 indicates a size ange of 160–169 mm and so on). It can be seen that more than 50% of the individuals above 180 mm in length were mature. The oozing ova of the mature females measured between 0.63 and 0.79 mm in diameter with an oil globule measuring between 0.09 and 0.12 mm in diameter.

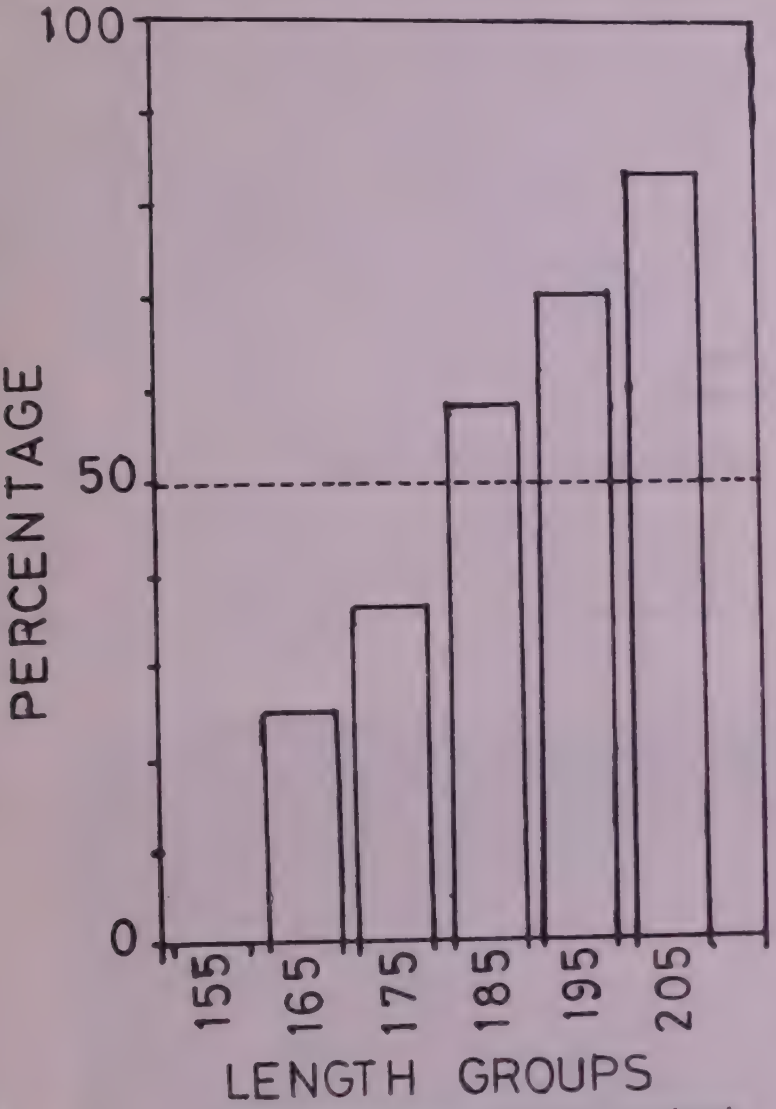

Fig. 6. Percentage of mature individuals in the 10 mm length group.

Fig. 8. Scads being loaded into trucks to be sent to distant places.

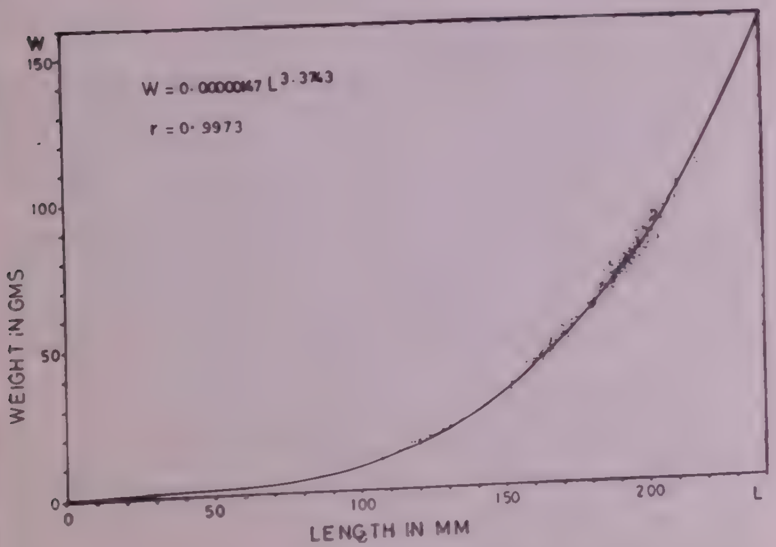

Fig. 7. Observed lengths and weights plotted against estimated relationship.

Fig. 9. Scads being gutted for beach-drying.

Length-weight relationship

The weight of *D. russelli* had the following relation with length:

$$W = 0.00000147 \ L^{3.3743}$$

The correlation coefficient had a value of 0.9973 (Fig. 7).

Price structure and utilisation

At Vellayil the wholesale price of scads was Rs. 150/- per basket (about 70 kg or 1000 fishes) in the beginning of this period. The price came down to Rs. 80/- by the end of the period. In the market the wholesale price ranged from Rs. 15 to Rs. 25 per 100 fishes and the retail price from Rs. 20 to Rs. 35 per 100 fishes.

Due to poor local demand truck-loads of scads were sent to other places where there was scarcity of fish (Fig. 8). On the days when catches were extremely high, about 25% of the scad catch was gutted, salted and dried on the beach (Fig. 9). *P. cyanea* being new to the area the customers were reluctant to buy it and most of the catch was dried whole on the beach. However, some people who tasted it reported that the fish was fine tasting.

* * *

BUMPER CATCH OF CAT FISH AT PONDICHERRY*

On 25-8-1986 shoals of Giant cat fish (*Arius thalasinus* Day) (Fig. 1) moving northward in the Bay of Bengal at a distance of 1 km from the Pondicherry port were noticed by the fishermen at Vembakeerapalayam at 1330 hrs. Immediately 23 fishermen headed by Shri Allimuthu, rushed their traditional fishing gears, *Edavalai* (Bagnet) to the spot with catamarans. The shoals were encircled quickly, and about 80 per cent of the shoals entered into the nets. The captive shoals drifted the nets further one km to the north. In the meanwhile, the fishermen sent signals to the villagers for assistance. Immediately two mechanised trawlers went to the spot and arrested the movements of the shoals. Simultaneously the remaining part (1,250 Nos.) of the shoals was also captured by the Vaithikuppam fishermen who operated their *Edavalai* nearby.

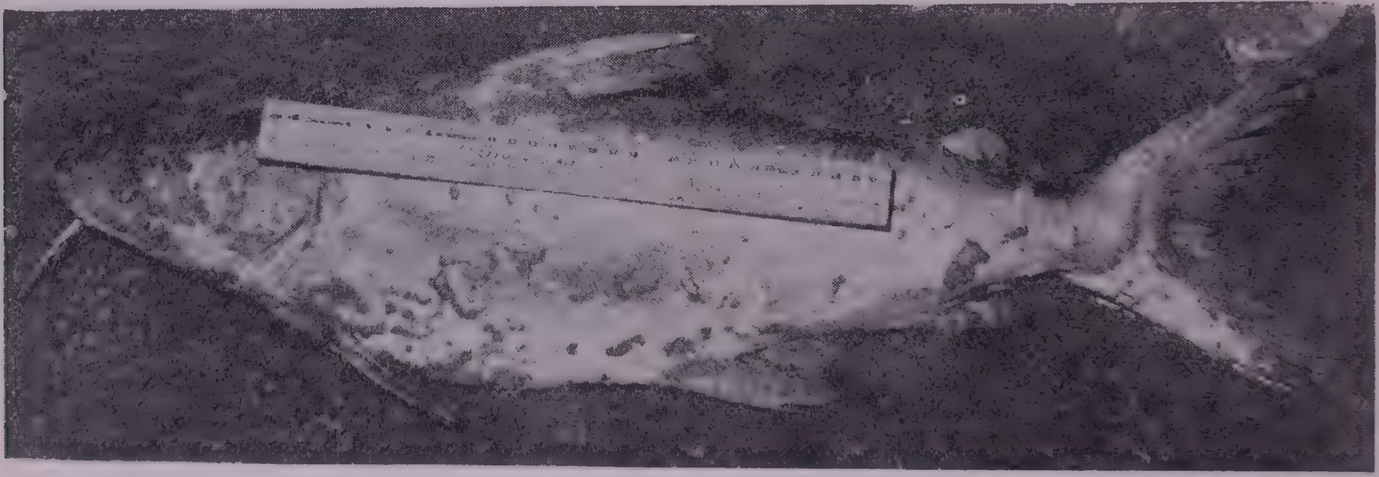

Fig. 1. *Arius thalasinus* the giant cat fish.

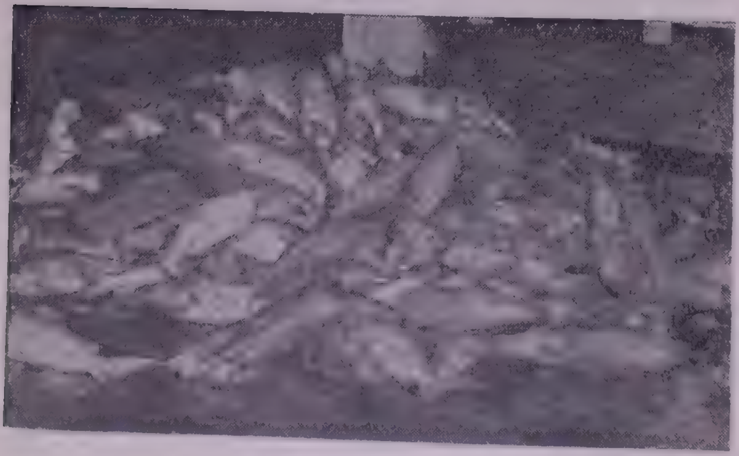

Fig. 2. Part of catch brought to the shore.

The Vembakeerapalayam fishermen brought the catch in several trips to the shore with the help of two mechanised trawlers from 1600 to 0330 hrs (Fig. 2). Nearly 4,300 fishes were sold to the merchants at the rate of Rs. 14/- per fish. The cat fishes were of uniform size and weight (75 cm length and 5 kg weight).

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*Reported by L. Chidambaram, Pondicherry Field Centre of CMFRI, Pondicherry.

ON THE OCCURRENCE OF SEEDS OF THREADFIN AND INDIAN SAND WHITING ALONG THE CALICUT COAST*

Occurrence of seeds of Threadfin *(Polynemus etradactylus)* and Whiting *(Sillago sihama)* was noticed or the first time along the Calicut coast during the last veek of November, 1985. The seeds were found in airly good numbers in the surf of Konnad beach exten-ling about 500 m length in the West Hill area. The Threadfin seed was available only during November, 985; whereas the availability of Whiting seed extended upto the end of January, 1986. The Threadfin seed was available at an average of 36 numbers per haul (179 numbers per hour). During the months of November and December the Whiting was available at a rate of .5 number per haul (2.2 per hour); whereas in January t was available at the rate of 39 per haul (196 per hour).

A total of 1,250 numbers of Threadfin seed ranging in size from 15 to 23 mm and 1,193 numbers of Whiting seed ranging in size from 30 to 50 mm were collected and utilised for culture experiments.

The seeds were collected by using an ordinary mosquito netting from the shallow waters upto 5 m distance from the shore line having a maximum depth of 1m. The early morning hours and high tide periods seemed to be the best time for the collection of seeds. The salinity and temperature of the water ranged between 32.8 and 33.5‰ and 28 and 30°C respectively in the area where the seeds were collected. The bottom of the ground was sandy and a good concentration of yellow-green algae was noticed in the area. Young ones of *Ambassis* sp., *Therapon* sp. and carangids were also found along with the above seeds.

Reported by S. Lazarus and K. Nandakumaran, Calicut Research Centre of CMFRI, Calicut.

ON AN UNUSUAL LANDING OF CAT FISH *ARIUS CAELATUS* (CUVIER AND VALENCIENNES) AT RAMESWARAM VERKOTTIL, TAMILNADU*

Pillai and Sathiadas *(Mar. Fish. Infor. Serv., T & E Ser.,* No. **39**: 1982) described the two boat, high pening trawl for pair trawling operations recently ntroduced at Rameswaram and Mandapam area under he Bay of Bengal Programme. They reported good shery for rainbow sardines and white pomfrets in the alk Bay. Accoring to them catfish contributes 9.32% orming an important subsidiary catch in the pair trawl ear. In this connection an unusual instance of the anding of cat fish *Arius caelatus* was observed on 9–1–'84 and the same is recorded in this note.

A total of five pair-trawl units were operated in shing area, 9/79–3C in Palk Bay on 19–1–'84 from 430 hrs to 1900 hrs. The H. P. of these boats ranged om 53.9 to 68.0, length from 9.2 to 9.8 m and the number of crew from 5 to 6 per boat. The trawling speed was about 2.5 knots.

The unusual catch of seven tonnes of cat fish was obtained in a single haul by one of the units operated by two STC boats, each with 68 H.P. diesel engine and length of 9.8 m. The catch was taken around 0630 hrs. About four tonnes of the catch were hauld on board from the net and the remaining portion of the catch was impounded in the net till bringing to the shore.

The composition and average quantity of catch of the five units in the areas were *Arius caelatus* 1,400 kg, *Dussumieria acuta* 300 kg, *Pampus argenteus* 80 kg, *Pellona* sp. 20 kg, *Caranx* spp. 15 kg, silver-bellies 8 kg and other fishes 10 kg. The total length of *Arius caelatus* in the unusual catch ranged from 275 to 300 mm and the weight from 1.2 to 1.5 kg.

Reported by S. Subramani, Regional Centre of CMFRI, andapam Camp.

Four tonnes of the cat fish catch was iced and sent to markets at Madurai and Coimbatore in fresh condition. The remaining three tonnes were salted and pit–cured. The price of iced fish was Rs. 1.60 per kg and that of salted fish Rs. 2.50 per kg.

Bumper catches of 3.0 and 4.5 tonnes of cat fish were landed on 16–2–'82 and 10–3–'82 respectively at the same landing centre by pair trawl units. From second week of January, 1984 onwards trial fishing using pair trawl gear was taken up by some fishermen in anticipation of good pomfret fishery in February. However, the present unusual fishery was encountered in one such trial fishing operation. In subsequent days, trial fishing did not yield any good catch. But on 2-2-'84 a catch of one tonne of cat fish was brought by one unit.

The cause for the present unusual fishery is not known. The sky was clear and the sea calm, the wind was westward and the current northward. Instances of unusual bumper catches for catfish are locally reported to be a new feature after introduction of pair trawl in these areas.

The author is thankful to Dr. P. Bensam and Shri P. Livingston for rendering help in the preparation of this note and to Shri V.S. Rengaswamy for identification of the species.

A NOTE ON AN UNUSUAL OCCURRENCE OF HORSE MACKEREL *MEGALASPIS CORDYLA* (LINNAEUS) IN THE KOVALAM BAY, MADRAS*

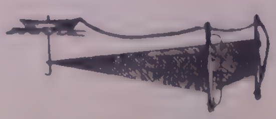
On 4th February, 1986, an unusual landing of *Megalaspis cordyla* was observed in the shore-seine catches from the Kovalam bay. From the earlier reports it was observed that the fishery of Kovalam was mainly supported by the lesser sardine, silverbellies, caranx, perches, sciaenids and elasmobranchs. In the present instance a total of 980 numbers of horse mackerel with an average weight of 1,015 g were obtained. An estimated total catch of 1,107.7 kg fish fetched a revenue of Rs. 5,990/- on that day which was an all time record for this fish.

The length of the fish landed measured between 390 and 520 mm and the modal value was at 400–440 mm which contributed 66% of the landings. The weight ranged between 700 and 1,400 g with an average of 1,015 g.

Environmental parameters showed that the salinity, temperature and dissolved oxygen of the surface water were 32.02‰, 29°C and 4.32 ml/1 respectively. The sea was calm and clear. The water current was moving gently from the northern side to southern side. The wind direction was towards south and its velocity was very low.

Analysis of stomach contents showed the presence of *Acetes indicus* which was also recorded in abundant quantities in the boat seine catches operated prior to the shore-seine operation.

It is likely that these shoaling fishes would have followed the prey *(Acetes indicus)* towards the shore where they were netted.



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*Reported by R. Thangavelu, P. Poovannan and K. Sahul Hameed, Madras Research Centre of CMFRI, Madras.

LARGE SCALE DAMAGE DUE TO FIRE AT THE VIZHINJAM FISH LANDING CENTRE*

On 25th July, 1986 a fire broke out in the thatched sheds on the western side of the Vizhinjam fish landing centre, inside the fishing harbour area, destroying a number of sheds and fishing materials stored inside. Some of the canoes beached were also gutted.

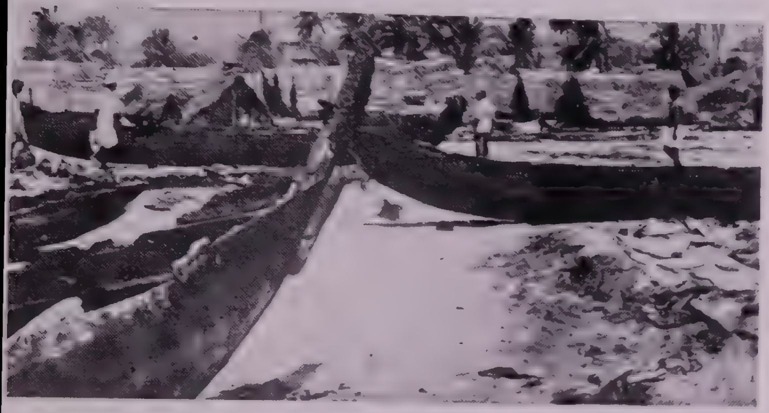

Fig. 1. A view of the beached canoes destroyed by the fire.

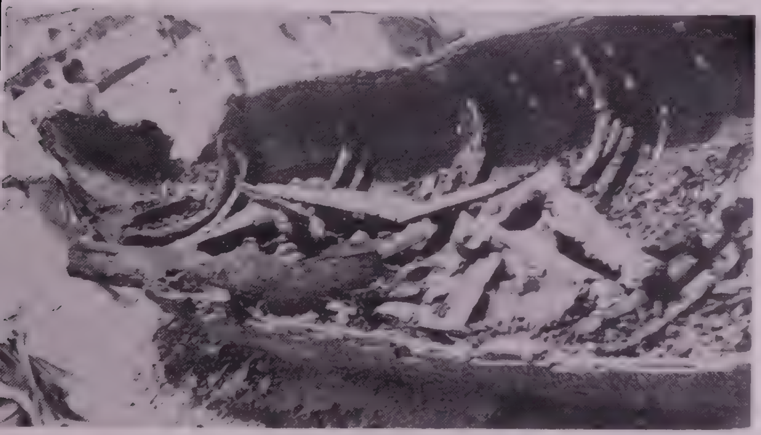

Fig. 2. A canoe turned to ashes by the fire.

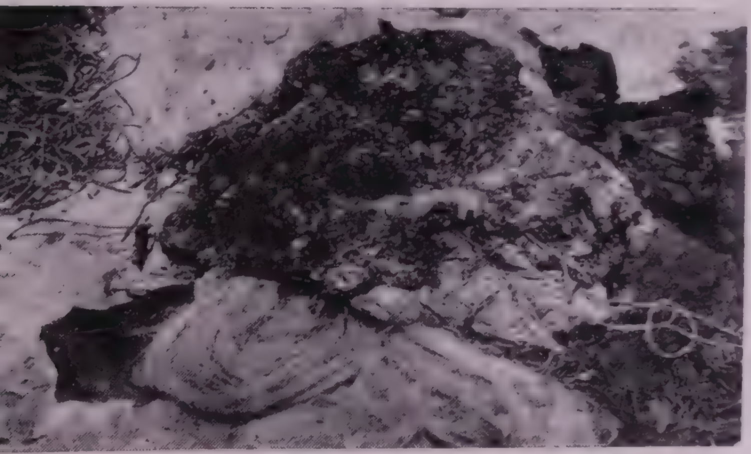

Fig. 3. Drift net unit burnt to a molten mass.

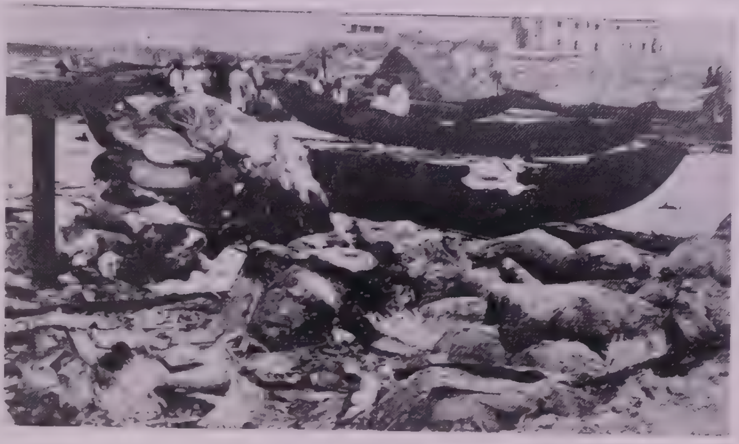

Fig. 4. Salt bags stored inside the shed.

The fire started around 1300 hrs from a thatched shed and it immediately spread to neighbouring sheds. The fire service squads from Trivandrum and Neyyattinkara rushed to the area and with the help of the local people they could control the fire from spreading far thus avoiding still heavier loss. Fortunately there were no casualties except for a few minor burn victims who were admitted in the hospital.

Nylon and coir fishing nets, salt bags, salted fish and other fishing materials stored inside these sheds were gutted. One outboard motor and many of the beached canoes were destroyed in this fire.

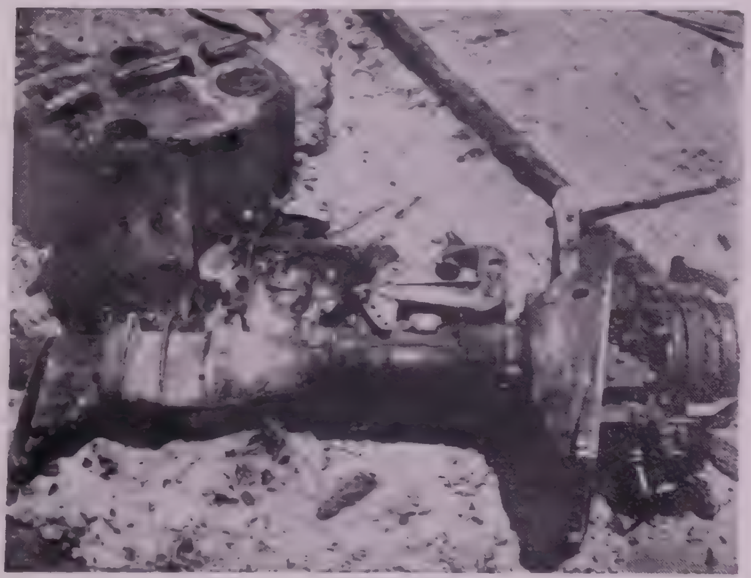

Fig. 5. An outboard motor destroyed in the fire.

According to the press nearly 40–50 sheds and 21 canoes were damaged and the total loss is estimated at more than Rs. 10 lakhs.

Reported by P. N. Radhakrishnan Nair, Vizhinjam Research entre of CMFRI, Vizhinjam.

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INDIAN COUNCIL OF AGRICULTURAL RESEARCH

THE MARINE FISHERIES INFORMATION SERVICE: Technical and Extension Series envisages the rapid dissemination of information on marine and brackish water fishery resources and allied data available with the National Marine Living Resources Data Centre (NMLRDC) and the Research Divisions of the Institute, results of proven researches for transfer of technology to the fish farmers and industry and of other relevant information needed for Research and Development efforts in the marine fisheries sector.

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Front cover photo:

'Black type' gorgonid (*Echinomuricea indica*)

Back cover photo:

'Black type' gorgonid (*Echinogorgia complexa*)

GORGONID RESOURCES OF INDIA

P. A. Thomas and Rani Mary George
Vizhinjam Research Centre of C. M. F. R. I., Vizhinjam

ntroduction

The colourful seafans have been objects of attracion to man from time immemorial. Those who had pportunity to watch them under water with their ariegate coloured polyps expanded have even considered them to be the 'flowers' of 'underwater gardens.' For these aesthetic reasons these animals have been ollected all over the world, and from India too they ave been exported under the head 'curio' for a long period. But the demand for this commodity was not t all specific and the revenue realised under this head was also not very attractive. However, the condition drastically changed by the beginning of 1970's and several countries started importing them in bulk from India.

Though the reason behind such large scale imports s not clear, it is inferred that the discovery of prostaglandins (PGE, PGF, PGE_2, PGF_2–alpha, PGF_2–beta and the like) in 1969 by Weinheimer and Spraggins from *Plexaura homomalla* (Esper), a Caribbean species, triggered off a world wide 'hunt' for the species or its congeners. Prostaglandins or derivatives thereof now serve as 'wonder drugs' for many-a-systemic disease n man and animal, and enamoured by their clinical possibilities several pharmaceutical firms have even stepped up their production on a commercial basis. The present demand for gorgonids of Indian waters may be said to be a part of this world wide 'hunt' for raw materials.

India stepped up commercial exploitation and export of gorgonids during 1975 and the material is now being exported to countries like France, West Germany, Belgium, U. S. A. and Netherlands, to mention a few. The quantity exported from India during 1975–'76 period was rather negligible, being a total of 552 kg valued t Rs. 9,206 averaging about Rs. 16 per kg. The average price/kg was on the increase till 1977–'78, but with the ecord export of 14.7 tonnes during 1978–'79 the price ame down for the year to an average of Rs. 10.97 per kg.

The quantity of gorgonids exported from India since then showed a downward trend, but the price/kg was on a steady increase. For 1,008 kg exported during 1983-'84 the total revenue realised was Rs. 1.04 lakhs, averaging Rs. 103.65 per kg. The year-wise export, total value realised and the price/kg are indicated below (Table 1).

Table 1.* *Quantity, price, price/kg of gorgonids exported from India during* 1975–'83

Period	Quantity (kg)	Total value (Rs.)	Price/kg (Rs.)
1975–'76	552	9,206.00	16.67
1976–'77	2696	57,106.00	21.18
1977–'78	7013	1,71,250.00	24.41
1978–'79	14760	1,62,051.00	10.97
1979–'80	4050	1,67,053.00	41.24
1980–'81	1849	60,388.00	32.65
1981–'82	3690	2,10,260.00	56.98
1982–'83	808	51,209.00	63.37
1983–'84	1008	1,04,485.00	103.65

*Based on data obtained from M.P.E.D.A., Cochin.

Classification of commercially important gorgonids of India

Anthozoans which include seafans, corals, sea anemones *etc.*, are exclusively marine cnidaria and are divided into two subclasses based on structural differences in their symmetry. The first subclass Octocorallia, which includes soft corals, seafans, seawhips *etc.*, is colonial in habit and the polyps have eight tentacles and the body cavity also is divided into eight radial compartments. The other subclass Zooantheria (also called Hexacorallia) which includes sea anemones, black corals, stony corals *etc.*, has hexamerous symmetry that may be biradial or radiobilateral in nature.

Of the six extant orders of the subclass Octocorallia, the Alcyonacea (soft corals) and Gorgonacea (seafans, sea whips *etc.*) are widely distributed in the coastal areas of the Indo-Pacific. From the pattern of abundance it may be stated that Gorgonacea forms the largest single contributor to the total biomass along our reefs.

Members of the Order Gorgonacea Lmx. have a skeleton composed of two parts – an outer cortex ('skin' or 'rind' as it may be called) containing loosely arranged calcareous spicules, and an inner medulla with solid axis made of calcareous or horny matter with or without the addition of calcareous spicules. Based on the arrangement of the skeleton this Order may be divided into two suborders – Scleraxonia and Holaxonia. The former suborder includes species with both spicules and horny material in the medulla while in the latter there is only horny matter.

Among the commercially important gorgonids of India, species of both Scleraxonia and Holaxonia are represented, the latter being more dominant than the former. The general classification of commercially esteemed species of Indian seas is as follows:

List of species

Order	Gorgonacea Lmx.
Suborder	Scleraxonia Studer
Family	Anthothelidae Broch
Genus	*Solenocaulon* Gray
1.	*Solenocaulon tortuosum* Gray
Family	Subergorgiidae Gray
Genus	*Subergorgia* Gray
2.	*Subergorgia suberosa* (Pallas)
3.	*S. reticulata* (Ellis and Solander)
Suborder	Holaxonia Studer
Family	Plexauridae Gray
Genus	*Plexauroides* Wright and Studer
4.	*Plexauroides praelonga* (Ridley)
Family	Paramuriceidae Bayer
Genus	*Muricella* Verrill
5.	*Muricella umbraticoides* (Studer)
6.	*M. complanata* Wright and Studer
Genus	*Thesea* Duchassaing and Michelotti
7.	*Thesea flava* Nutting
Genus	*Echinomuricea* Verrill
8.	*Echinomuricea indomalaccensis* Ridley
9.	*E. indica* Thomson and Simpson
Genus	*Echinogorgia* Kolliker
10.	*Echinogorgia reticulata* (Esper)
11.	*E. flora* Nutting
12.	*E. complexa* Nutting
Genus	*Heterogorgia* Verrill
13.	*Heterogorgia flabellum* (Pallas)
Family	Gorgoniidae Lmx.
Genus	*Leptogorgia* Milne Edwards
14.	*Leptogorgia australiensis* Ridley
Family	Ellisellidae Gray
Genus	*Ellisella* Gray
15.	*Ellisella andamanensis* (Simpson)
16.	*E. maculata* Studer
Genus	*Nicella* Gray
17.	*Nicella dichotoma* (Gray)
Genus	*Juncella* Val.
18.	*Juncella juncea* (Pallas)
Genus	*Gorgonella* Val.
19.	*Gorgonella umbraculum* (Ellis and Solander)
20.	*G. rubra* (Thomson and Henderson)
Genus	*Scirpearia* Cuvier
21.	*Scirpearia filiformis* Toepl.
Family	Isididae Lmx.
Subfamily	Isidinae Lmx.
Genus	*Isis* Lin.
22.	*Isis hippuris* Lin.

The above list shows that the total number of species exported from India at present is 22 and these are referable to 7 families and 15 genera. Scleraxonian species are not many and the majority of commercial species fall under Holaxonia; the important families being Paramuriceidae and Ellisellidae with nine and seven species respectively.

Commercial classification of Indian gorgonids

Gorgonids exported from India are commercially classified under four heads or 'types': 'Black', 'Red', 'Flower' and 'Monkey tail.' The examination of export data from some places indicates that another type by name 'White' was included at some centres in the past. But this 'type' is nothing but the name given to the skeleton of undersized 'Red type' gorgonids from which the outer coloured cortex (skin) has been removed.

The commercial classification thus is based mainly on colour and body form and on generic affinity, whatsoever, is taken into consideration. The following may be given as the salient features of each 'type' and the species falling under each.

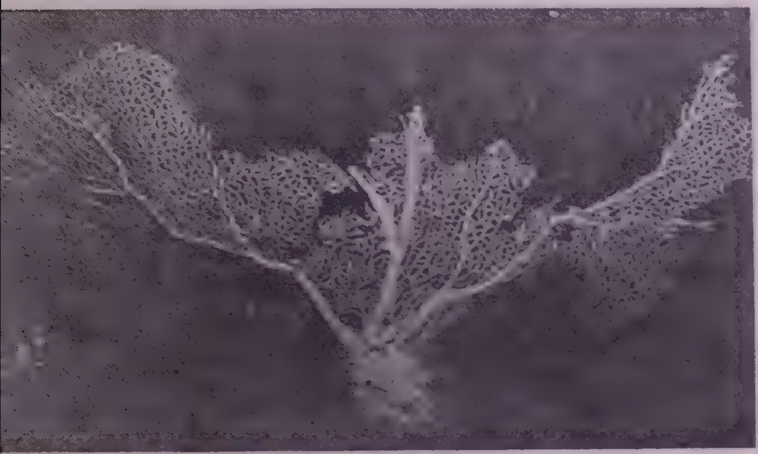
1. *'Black type':* Specimens are black or dark brown in colour and the body pattern may be mostly reticulated.

ranches divide in one plane and give rise to an ovate o obovate colony form; stalk may be short and stout. n the list of species Nos. 9, 12 and 13 fall under this ype (front cover photo).

2. *'Red type':* Specimens may be pink or brick ed in living condition. Body pattern resembles very much that of the above type. Nos. 2, 3, 4, 6, 8, 10 and 19 of the list of species come under this type (Fig. 1).

3. *'Flower type':* Specimens may be yellow, red, orange, white or cream in colour. Body pattern may be lamellar or bushy with free branches. Young specimens of 'Red type' may often be sorted out under this category. In the list of species Nos. 7, 11, 14, 15, 17 and 20 and also young specimens of No. 4 may be classified under this category (Fig. 2).

4. *'Monkey tail type':* Colony long and whip-like; seldom branching, if dividing, often dichotomously. Nos. 16 and 18 given in the list of species are of this type (Fig. 3).



ig. 1. 'Red' type gorgonid *(Subergorgia reticulata (*Ell. & So.)

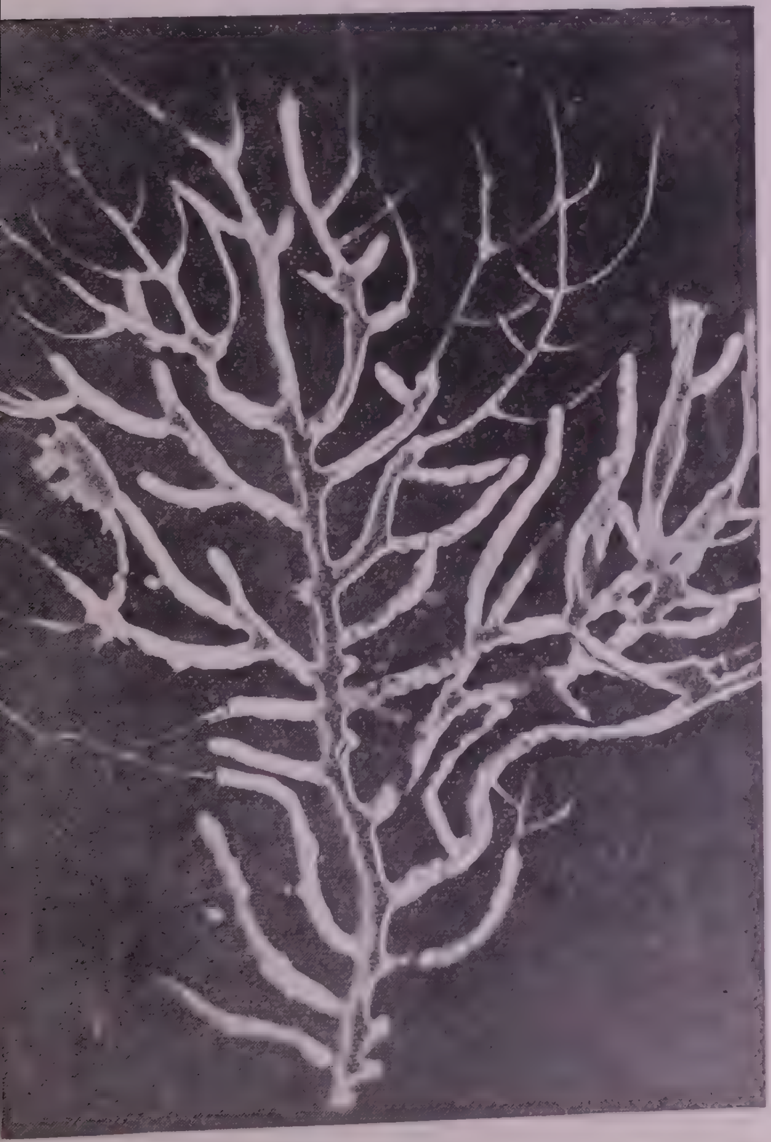


Fig. 2. 'Flower' type gorgonid *(Leptogorgia australiensis* Ridley).

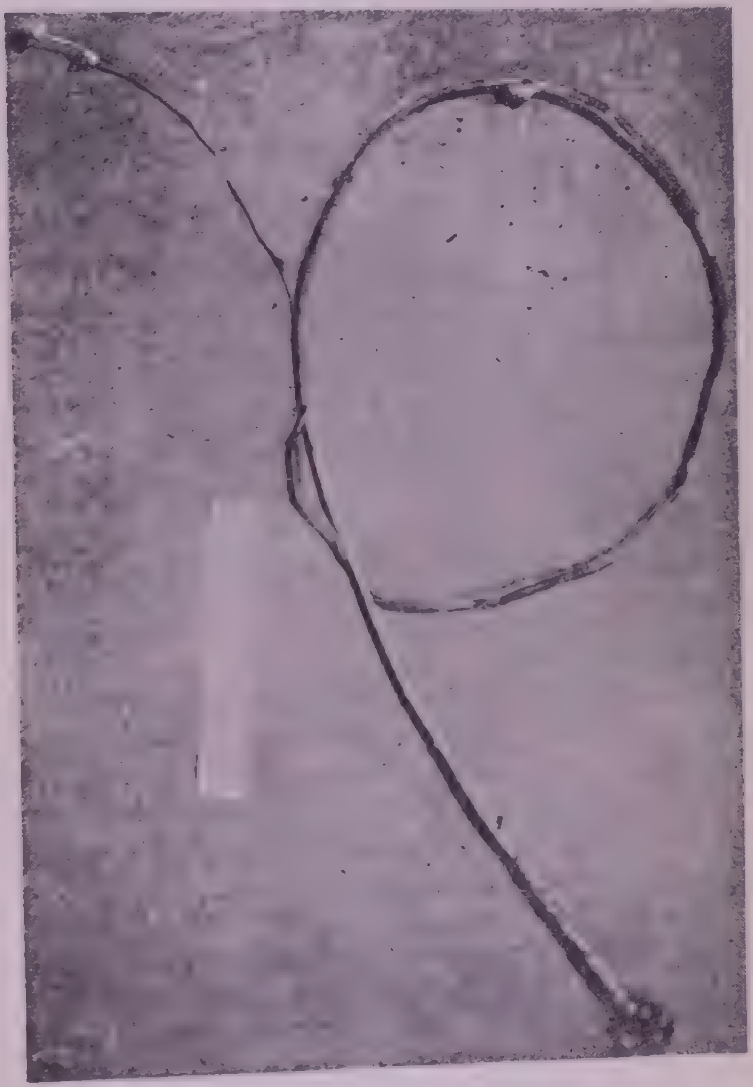


Fig. 3. 'Monkey tail' type gorgonid *(Juncella juncea* (Pallas).

Type-wise composition

In order to find out the percentage contribution of each 'type' to the fishery, the details were analysed from three centres *viz*. Tuticorin, Keelakarai and Rameswaram. This reveals that the average contribution of the 'Black type' to the fishery was 38.3%, of the 'Red type' 25.7%, of the 'Monkey tail type' 20.3% and of the 'Flower type' 15.7%. Species that dominated in the fishery from each type were, in the order of abundance, Nos. 9 *(Echinomuricea indica)*, 13 *(Heterogorgia flabellum)* and 12 *(Echinogorgia complexa)* of the 'Black type'; Nos. 19 *(Gorgonella umbraculum)*, 3 *(Subergorgia reticulata)* and 2 *(Subergorgia suberosa)* of the 'Red type'; No.14 *(Leptogorgia australiensis)* of the 'Flower type' and Nos. 18 *(Juncella juncea)* and 15 *(Ellisella andamanensis)* of the 'Monkey tail type.' In all the three centres studied the first mentioned species from each 'type' dominated well over the others in the landings.

Distribution along the Indian coasts

Gorgonids, though distributed widely along the coasts of India, are available in fishable magnitude only in the Gulf of Mannar and hence it may be stated that the gorgonid export depends mainly on catches from the three major centres in the Gulf of Mannar, *viz.* Tuticorin, Rameswaram and Keelakarai. During the formative years (1975–'79) the merchants engaged fishermen directly for collecting gorgonids. But this condition changed subsequently in all the major centres. Fishing exclusively for gorgonids became less common and merchants started appointing their agents in different places to collect specimens from fishermen who, in turn, started gathering them as and when they dive for chank or mussel or fished with trawl nets, traps or bottom set gill nets *etc.* Such collection centres are distributed both along the southeast coast (upto Madras) and southwest coast (upto Quilon) of India.

The general distribution of the various commercially important species along the Indian coasts is quite interesting as it shows difference with regard to their number and abundance. Many species that are abundant in the Gulf of Mannar are sparse elsewhere. Species such as *Heterogorgia flabellum, Gorgonella umbraculum* and *Juncella juncea* are rather exceptional and exist in fishable magnitude in several areas along the east and west coasts of India and Andamans. *Isis hippuris,* on the other hand, has been collected only from Andamans. This species is exported for making ornaments.

From the point of view of species composition, it may be stated that the maximum number of species from each 'type' is fished from the Gulf of Mannar. The total number of species collected at each centre may be indicated as follows: Tuticorin – 14 species; Keelakarai – 10 species; Rameswaram – 10 species; Nagapattinam – 2 species; Madras – 8 species; Cape Comorin – 8 species; Muttom – 2 species; Kadiapattinam – 6 species; Colachel – 3 species; Thengapattinam – 2 species; Vizhinjam – 3 species; Quilon – 2 species and Andamans – 2 species. The distribution of species in the northern parts of both east and west coasts of India is not well known, but based on published accounts it may be stated that both 'flower' and 'red' types are available along Dwaraka, Ratnagiri and Visakhapatnam areas.

Species represented in the commercial landings from the above centres are listed below. The number given refers to the serial number of species given in the 'List of species' (*vide supra*).

1. Tuticorin: Nos. 2, 3, 4, 6, 7, 9, 10, 12, 13, 14, 17, 18, 19 and 20.
2. Keelakarai: Nos. 2, 3, 4, 9, 12, 13, 14, 15, 18 and 19.
3. Rameswaram: Nos. 2, 3, 7, 9, 10, 12, 13, 14, 18 and 19.
4. Nagapattinam: Nos. 13 and 19.
5. Madras: Nos. 3, 5, 8, 9, 10, 13, 14 and 19.
6. Cape Comorin: Nos. 1, 6, 12, 13, 14, 18, 19 and 21.
7. Muttom: Nos. 19 and 20.
8. Kadiapattinam: Nos. 6, 15, 16, 18, 19 and 20.
9. Colachel: Nos. 12, 13 and 18.
10. Thengapattinam: Nos. 13 and 19.
11. Vizhinjam: Nos. 11, 18 and 19.
12. Quilon: Nos. 13 and 19.
13. Andamans: Nos. 19 and 22.

The following species have been reported for the first time from the Indian seas: 1) *Thesea flava* Nutting, 2) *Echinomuricea indica* Thomson and Simpson, 3) *Echinogorgia flora* Nutting, 4) *E. complexa* Nutting and 5) *Heterogorgia flabellum* (Pallas).

Fishing seasons

During the northeast monsoon (October–March) the coastal areas of the Palk Bay become rough and choppy but the inshore areas of the Gulf of Mannar remain comparatively calm and hence fishing could be carried out unhindered in the Gulf of Mannar coast. By March the wind changes direction, as a result of which the inshore areas of the Gulf of Mannar become choppy and this condition prevails up to September. Such periodic reversal of monsoon winds influences the fishing activities of the region. Depending on the reversal of monsoon winds there are obviously lean and brisk periods for the gorgonid fishing also.

An added advantage with regard to the Gulf of Mannar is the occurrence of a long chain of islands extending from Tuticorin to Rameswaram Island. The total extent of this chain is about 140 km and the number of islands in the chain is 20. The sea in between these islands and the mainland is 5–15 m deep. Fishing in the nearshore areas of the mainland as well as those parts of the islands which are in the shadow of north-east monsoon is usually attempted during October–March period. During the southwest monsoon period the condition changes altogether, *i.e.* those areas of the islands facing the southwest monsoon winds and also the nearshore areas of the mainland become rough while areas of the islands facing away from the monsoon winds become calm and favourable for fishing.

In order to find out the seasonality of gorgonid landings, month-wise data obtained from three important centres such as Tuticorin, Keelakarai and Rameswaram have been analysed. The availability of gorgonids at both Rameswaram and Keelakarai follows a set pattern with peaks during April–May and January–March, the latter being dominant. But the fishery at Tuticorin is somewhat different in that the prolonged lean period noted during July–January at the other two centres is not so well pronounced. The relatively short duration of both monsoons coupled with the presence of well protected islands in the inshore areas, may be mentioned as the reasons for the protracted fishing activity noted here.

As compared to the southeast coast, the conditions prevailing on the southwest coast of India are quite different since both monsoons are equally intense here. Along the southwest coast a regular fishery for gorgonids is nonexistant and the little quantity brought ashore by fishermen engaged in trap fishing, trawling, mussel or chank fishing is transferred to the merchant or to their agents from time to time. Besides, sometimes the fishermen also keep stray catches with them for a long period before they are sold to the merchants/agents and hence information on the month-wise collection of gorgonids could not be ascertained in detail here.

Trend of fisheries

The species constituting each 'type' are not equally distributed among the various centres surveyed. However, the most common and heavily fished species are *Echinogorgia indica*, *Heterogorgia flabellum* (both of the 'Black type'), *Gorgonella umbraculum* ('Red type'), *Juncella juncea* ('Monkey tail type') and *Leptogorgia australiensis* ('Flower type'). At present the above said five species form the mainstay of Indian gorgonid fishery.

A perusal of Table 1 shows that gorgonid export from India started with 552 kg in 1975–'76. The price/kg realised for this quantity was a little over Rs. 16/-. What followed in the subsequent years, judged from the standards of any exporting country, was rather spectacular, for the export by 1978–'79 reached a peak of 14.7 tonnes valued at Rs. 1.62 lakhs. But, the price realised per kg was only Rs. 10.97. Probably, this record output of Indian gorgonid affected the available stock rather adversely, and the sudden dip in the price structure noted was perhaps due to the dominance of undersized specimens in the export samples. During the ensuing years, there was, however, very clear indication of a reorientation in the gorgonid fishery in our waters partly due to the poor revenue realised during the year of record export and also due to the strict size-quantity regulations imposed by a few foreign agencies. This situation prompted the fishermen to venture into new areas in search of larger specimens. The cumulative effect of all these measures, no doubt, resulted in a major cut in the quantum of our exports from 14.7 tonnes of 1978–'79 to four tonnes during 1979–'80. But this reduction in quantity apparently produced no corresponding effect on the revenue realised, which was estimated at Rs. 1.67 lakhs, with a record price of Rs. 41.24 per kg. The quantity exported from India, since then, began to show a downward trend and by 1983–'84, it came down to 1,008 kg. But the price/kg, on the contrary, registered a steady increase and by 1983-'84 it touched a peak of Rs. 103.65/kg.

Summing up the export trend over these years it may be stated that the export of this commodity from India during first five years (1975–'79) was to the tune of 25 tonnes while the same for the next five years (1980–'84) was only 11 tonnes. But in terms of revenue the latter period realised a total of Rs. 5.9 lakhs as against Rs. 3.9 lakhs obtained in the former period. There is indication that indiscriminate fishing in conventional grounds in the early period (*i.e.* period up to 1979) has affected our coastal beds while fishing in distant beds during the subsequent years (up to 1984) for larger specimens fetched a higher price in the foreign market. But care has to be taken even now to see that these beds also are not indiscriminately exploited and depleted.

Such a possibility of selective depletion of particular gorgonids in the major centres along our coasts requires mention in this context for three reasons.

a) 'Black' and 'Red' types were the first to be exported from India.

b) The above types are more common in our waters and they enjoy almost the same bathymetric distribution. Their price structure also is more or less the same in foreign market depending upon the size.

c) Skeleton of 'Red type' started appearing in export samples as 'White type' in some places. This indirectly influenced the exploitation of undersized 'Red type' specimens in all the important centres.

The component species constituting the four major 'types' were not subjected to fishing pressure at the same rate. Area-wise analysis indicates that in all the three major centres surveyed (*i.e.* Keelakarai, Tuticorin and Rameswaram) along the Gulf of Mannar coast, 'Black type' dominated (namely *Echinomuricea indica* and *Heterogorgia flabellum)* and was followed by the 'Red type' *(Gorgonella umbraculum)*. This clearly indicates that only three species were being exploited in large quantities and hence they are to be considered the direct victims of indiscriminate fishing.

Quantitatively speaking, the other two types, *viz.*, 'Monkey tail' and 'Flower', were exported at 20–22% level of the total and, as such, the problem of depletion has not yet reached any alarming scale for them. It is hence advisable to enhance their exploitation by increasing the effort in all centres where they are not fished in appreciable quantities at present.

Areas where fishing could be intensified

The areas where gorgonid fishing is active at present are indicated in Fig. 8 by continuous lines and virgin areas to which fishing could be extended profitably in future by interrupted lines. At centres like Dwaraka, Ratnagiri and Visakhapatnam the availability of gorgonids could be assessed only up to the 'type' level. These studies indicate that 'Flower type' is plenty at all these centres. At present no harvest of gorgonid is made from these areas and hence attempts may be initiated to exploit them in moderate quantities to supplement the landing from other centres.

To present a clear picture of the availability of various species in the proposed extended fishing areas (Fig. 8) the coast line is considered under eight zones: zones 1–4 on the east coast and 5–7 on the west coast. The Andaman group of islands is shown separately as Zone 8.

Zone 1. *Cape Comorin to Thiruchendur*

Gorgonids are occasionally collected from scattered centres like Perumanai, Periatalai, Manapad and Thiruchendur. Specimens of almost all species available at Tuticorin are distributed throughout this zone upto a distance of 4 km from the shore. It was also found during the present investigation that specimens of *Solenocaulon tortuosum* Gray are available in fishable magnitude off Cape Comorin at depths varying between 50 and 60 metres.

Zone 2. *Tuticorin to Rameswaram*

This zone, at its southern part, embraces the most extensive and heavily fished beds of India. Fishing in this part of the zone should be restricted in future as per guidelines provided in the section on 'some regulatory measures to be adopted' (*vide infra*).

The rest of this zone, that is the coastal area extending between Keelakarai and Rameswaram, includes the two major fishing centres *viz.*, Keelakarai and Rameswaram. Though a lucrative fishery existed at Keelakarai in the initial years (1975-'79), fishing became a less viable proposition in the subsequent period for want of sufficient returns. The other fishing centre, *viz.* Rameswaram depends mainly on the collections made from the various islands as also from the shallower areas off Mandapam Peninsula. At present the specimens are being collected by fishermen in their spare time. This area is rich in species like *Echinoforgia reticulata, Thesea flava, Juncella juncea, Plexauroides praelonga* and *Subergorgia suberosa.* The area between Hare Island and Pulli Island has a rich bed with a high frequency for larger specimens at a depth of 15 metres. This bed harbours species like *Echinomuricea indica, Heterogorgia flabellum, Gorgonella umbraculum* and *Juncella juncea.*

The Palk Bay side of Mandapam Peninsula and Rameswaram Island, especially the two semifossilised coral reefs called Kathuvallimuni Reef and Vellapertumuni Reef harbours a rich assemblage of gorgonids. *Leptogorgia australiensis* is rather wide spread all through these reefs. Other species such as *Echinogorgia reticulata, Subergorgia suberosa* and *Gorgonella umbraculum* are also available in moderate quantities. Exploitation of gorgonids from Devil's Point (Rameswaram Island), from areas outside the present limits, could also be attempted on an enhanced rate. Resource-wise the shallower areas extending between Devil's Point and Bathing Ghat (marked BG in map) may also provide a good area.

Zone 3. *Tondi to Point Calimere*

In this zone gorgonid exploitation is practiced as a part-time avocation only at two places – Tondi and

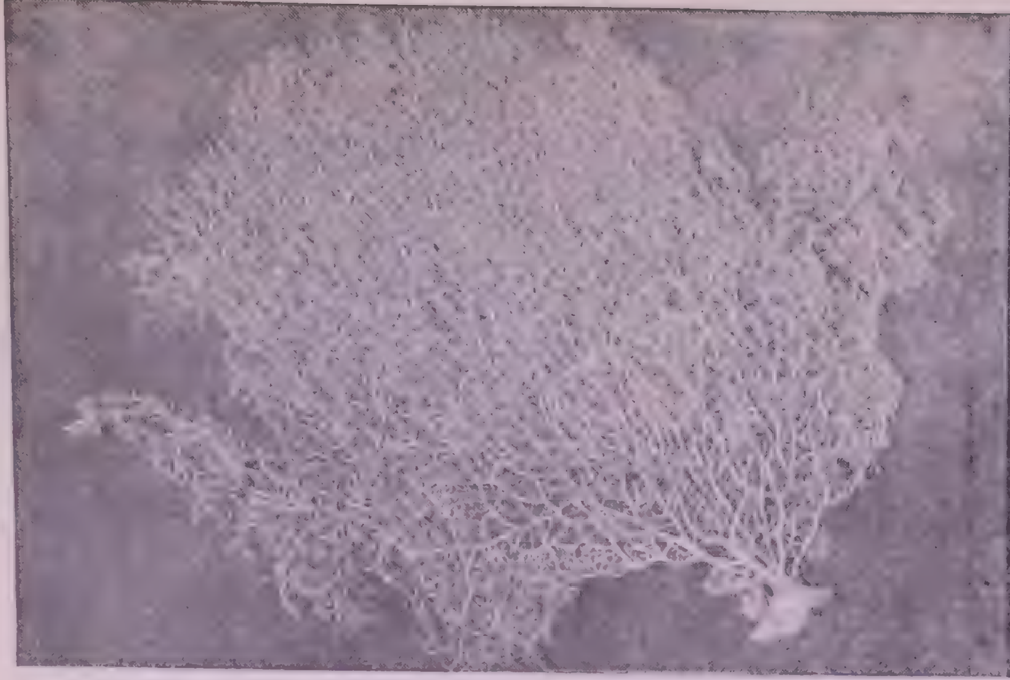


Fig. 4. The 'Black type' gorgonid (*Heterogorgia flabellum*).

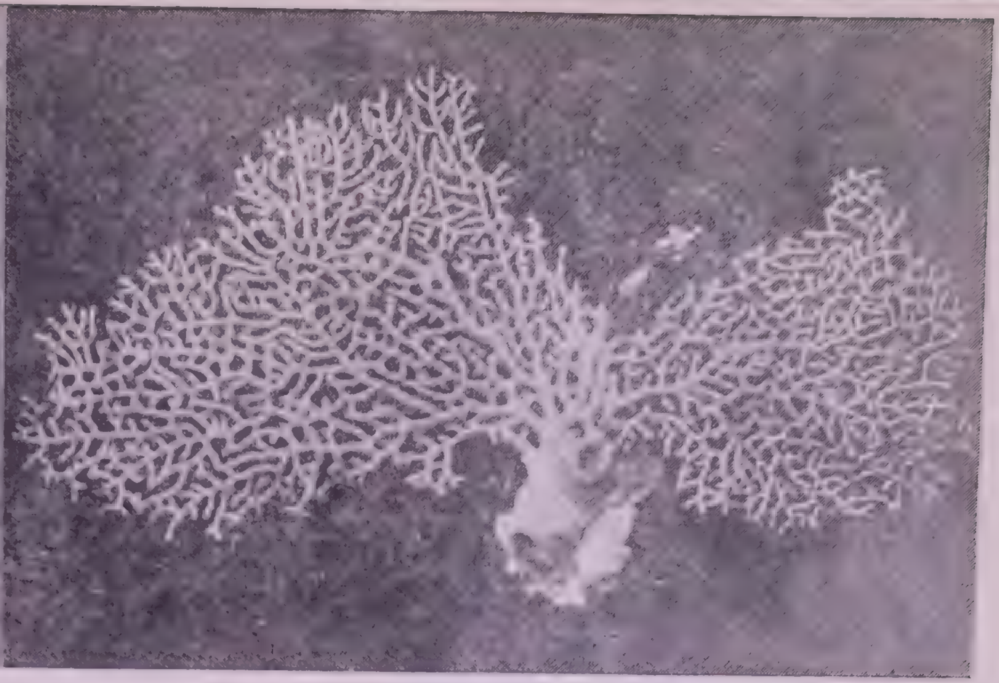


Fig. 5. The 'Red type' gorgonid (*Gorgonella umbraculum*).

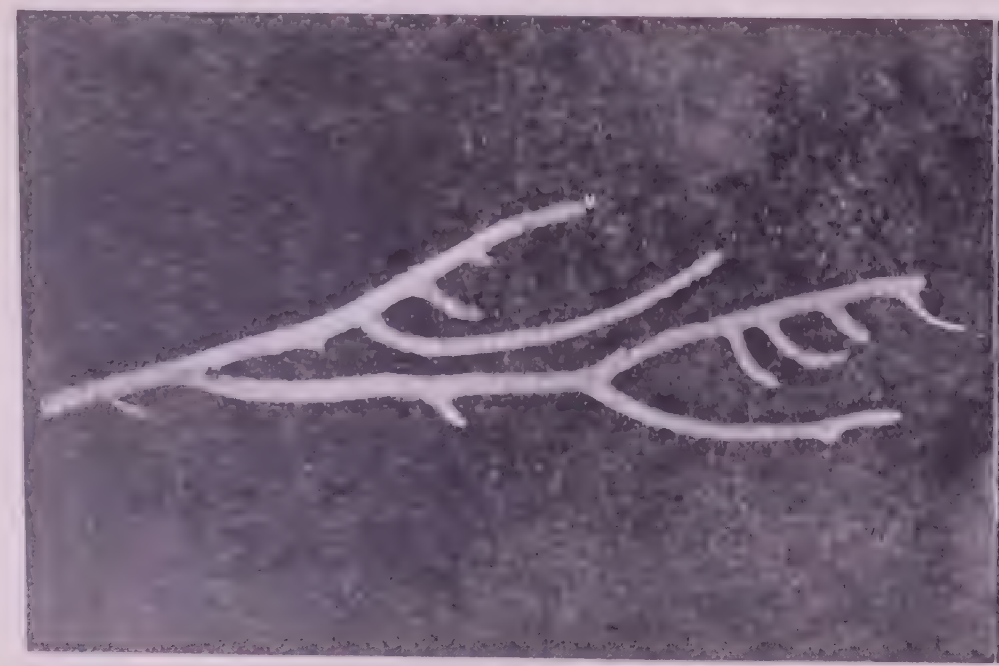


Fig. 6. The 'Red type' gorgonid (*Subergorgia suberosa*).

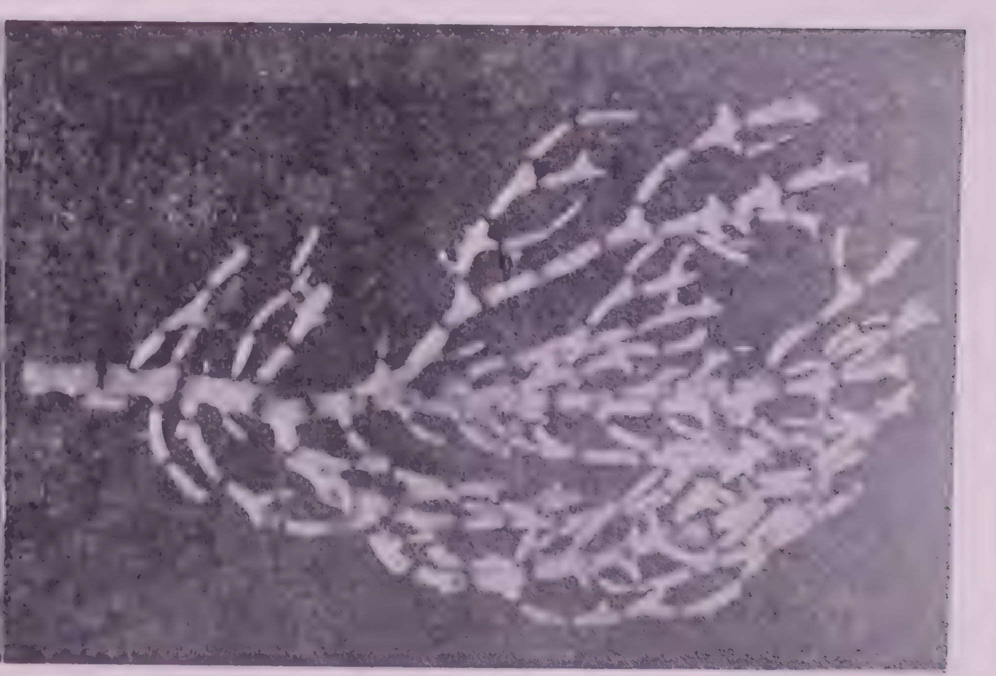


Fig. 7. *Isis hippuris*, a gorgonid used for making ornaments.

Point Calimere. Gorgonids are abundant all along this coast in shallower areas and attempts could be initiated to exploit them judiciously. A better season for their exploitation would be the pre-northeast monsoon months as the growth of specimens is likely to get retarded during the northeast monsoon period due to excessive silt fall.

Zone 4. *Visakhapatnam*

Since gorgonid exploitation is not in vogue at present, trials in this line would be desirable. 'Flower', 'Red' and 'Black' types are quite common in this zone.

Zone 5. *Okha, Dwaraka and the Gulf of Kutch*

Commercial exploitation of gorgonids has not yet been started here. In several places along this zone vast stretches of intertidal areas get exposed during low tide rendering hand picking of specimens rather easy. Places in and around Beyt Island, Adatra Reef, Chindi Reef, Balapur Bay, Mangunda Reef and areas off Dwaraka are rich in both 'Flower' and 'Monkey tail' type specimens, which are common upto a depth of 7 metres.

Zone 6. *Ratnagiri to Malvan*

'Red' and 'Flower' types are plenty in areas where the sea bottom is studded with rocks *etc.* Attempts could be initiated to exploit them on a commercial basis.

Zone 7. *Vizhinjam to Cape Comorin*

There is no organised fishery for gorgonids in this zone at present. In view of the richness, mainly in species such as *Gorgonella umbraculum, Heterogorgia flabellum, Echinogorgia complexa, Leptogorgia australiensis* and *Juncella juncea* attempts may be made to exploit them at an enhanced rate.

Zone 8. *Andamans*

Exploitation of *Gorgonella umbraculum* ('Red type') and *Isis hippuris* may be attempted.

Present status of our gorgonid beds

Since the gorgonid export from India is solely dependent on specimens fished from the Gulf of Mannar, the sign of depletion is felt much in all the fishing centres in the Gulf of Mannar. Details collected from three main centres such as Tuticorin, Keelakarai and Rameswaram clearly indicate that the depletory trend is not alike in all the three centres and this may be attributed to the distribution pattern of the various species and also on the difference in the fishing intensity effected from time to time.

The information gathered from the three major centres mentioned above throws considerable light on the problem of depletion in general. A centre-wise list of species which indicates clear cut mark of depletion, those with no signs of depletion where fishing could be carried out at the present level and those in which fishing could be intensified in future, is appended below. The notations 'B', 'R', 'F' and 'M' after each species denote 'Black', 'Red', 'Flower' and 'Monkey tail' types respectively.

Centre 1: *Tuticorin*

a) Species showing distinct depletory trend
Echinomuricea indica (B)
Gorgonella umbraculum (R)
Heterogorgia flabellum (B)
Echinogorgia complexa (B)

b) Species without any depletory trend
Subergorgia suberosa (R)
S. reticulata (R)
Plexauroides praelonga (R)
Muricella complanata (R)
Thesea flava (F)
Echinogorgia reticulata (R)
Leptogorgia australiensis (F)
Juncella juncea (M)

c) Species which could be intensively fished
Nicella dichotoma (F)
Gorgonella rubra (F)

Centre 2: *Keelakarai*

a) Species showing distinct depletory trend
Echinomuricea indica (B)
Gorgonella umbraculum (R)
Heterogorgia flabellum (B)

b) Species without any depletory trend
Echinogorgia complexa (B)
Leptogorgia australiensis (F)
Ellisella andamanensis (F)
Juncella juncea (M)

c) Species which could be intensively fished
Subergorgia suberosa (R)
S. reticulata (R)
Plexauroides praelonga (R)

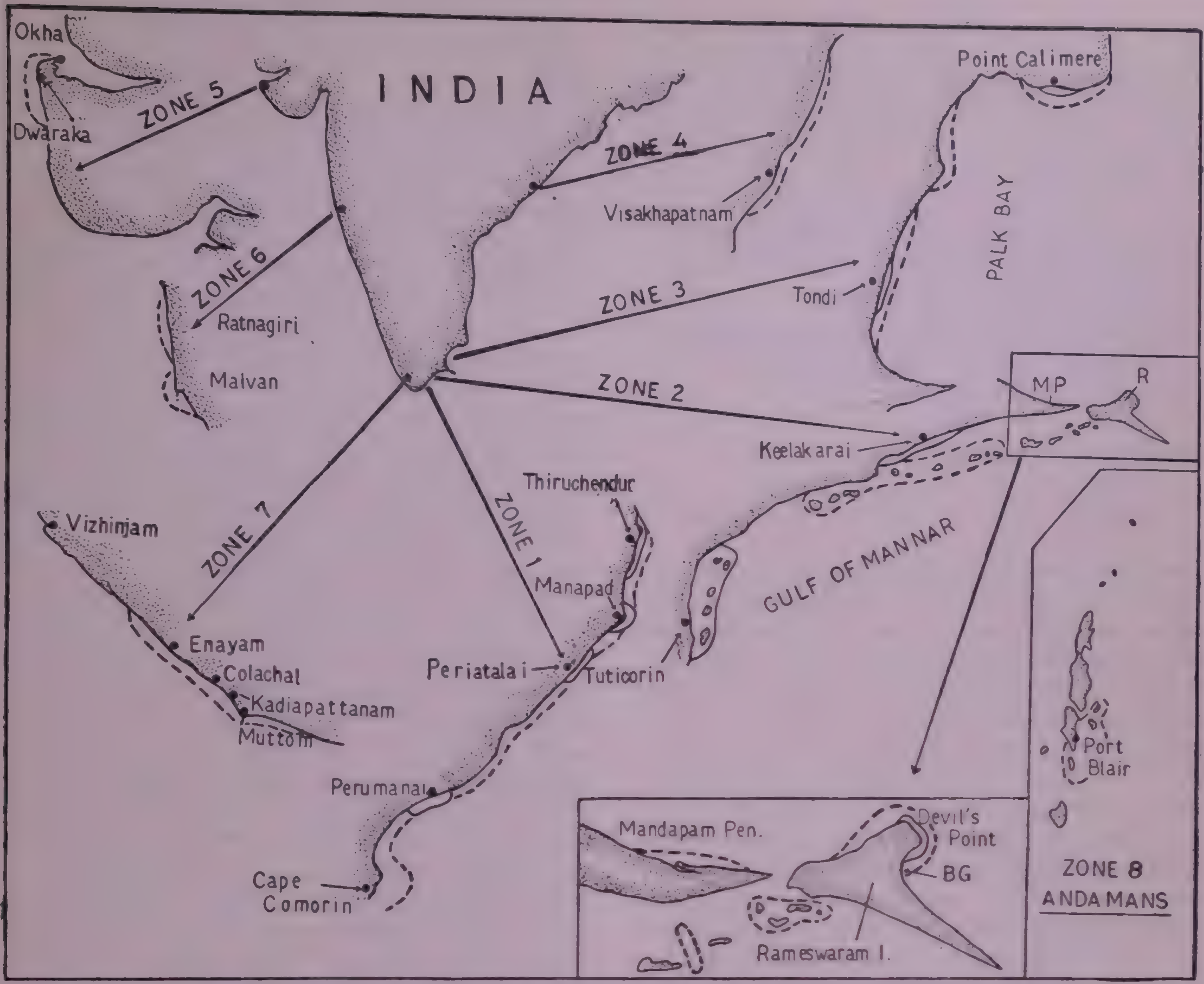

INDIA
Okha
Dwaraka
ZONE 5
ZONE 4
Visakhapatnam
Point Calimere
PALK BAY
ZONE 6
Ratnagiri
Malvan
ZONE 3
Tondi
ZONE 2
MP
R
Keelakarai
GULF OF MANNAR
ZONE 7
Vizhinjam
Thiruchendur
ZONE 1
Manapad
Enayam
Colachal
Kadiapattanam
Muttom
Periatalai
Tuticorin
Perumanai
Cape Comorin
Mandapam Pen.
Devil's Point
BG
Rameswaram I.
Port Blair
ZONE 8 ANDAMANS

Fig. 8. Exploited and potential areas where fishing for gorgonids is going on at present are indicated by continuous lines and where fishing could be extended in future are indicated by broken lines. R - Rameswaram Island, MP - Mandapam Peninsula and BG - Bathing Ghat. Each zone is magnified and given separately.

Centre 3: *Rameswaram*

a) Species showing distinct depletory trend
  Echinomuricea indica (B)
  Heterogorgia flabellum (B)
  Gorgonella umbraculum (R)

b) Species without any depletory trend
  Subergorgia suberosa (R)
  S. reticulata (R)
  Thesea flava (F)
  Echinogorgia complexa (B)
  Juncella juncea (M)

c) Species which could be intensively fished
  Echinogorgia reticulata (R)
  Leptogorgia australiensis (F)

The absence of any stock assessment of gorgonids in our waters prior to the commencement of their commercial exploitation makes the assessment of damage caused to them by indiscriminate fishing rather complicated. During the present investigation it was found that the condition of many of our erstwhile rich beds in the Gulf of Mannar was alarmingly poor. Though the depletory trend is discernible only in the case of four species mentioned under Column (a) at each centre, a *ban on the collection of these four species from the Gulf of Mannar alone will not produce any desired effect, for any collection in these grounds can be claimed to come from outside the present limits.* Hence it is necessary to *extend such a ban to all new areas* indicated in Fig. 8. It is quite certain that if such a ban is imposed atleast for a *period of* 10 *years* it would lead to a drastic cut in the export of gorgonids from India as these four species form the mainstay of our export at present. Anticipating such an eventuality alternative steps to maintain a regular supply of a minimum quantity every year/season by diversifying the fishing activities may be adopted well in advance and this should be formulated in the following lines:

1) By enhancing the fishing of all the species mentioned under Column (c) from the Gulf of Mannar and other new areas.
2) By extending the fishing activity to new areas indicated in Fig. 8 for species not included under Column (a).

Chemicals from gorgonids

a) *Prostaglandins*

Gorgonids were relatively unknown to chemical and medical world till 1969 when Weinheimer and Spraggins discovered the presence of prostaglandins in the gorgonid *Plexaura homomalla* (Esper) so common in the reefs off Florida. The compounds which they extracted from *P. homomalla, i.e.* 15-epi-PGA_2 (I) and its diester (II) present in the air-dried cortex to the extent of 0.2 and 1.3% respectively are epimeric with the potent mammalian hormone at the allylic hydroxyl centre. They are also devoid of the dramatic blood pressure lowering effect (demonstrated in dogs) of PGA_2. Though possessing the same gross structure as in mammalian PGA_2, compound (I) was found to be inactive in physiological tests suggesting diasteromerism at one or more of its five possible sites in the molecules. Further, the workers opined that in the current state of limited supply of mammalian prostaglandins the availability of large quantities of (I) and (II) from the widely distributed gorgonids invites their thorough evaluation as possible synthetic precursors to current members of this important hormone system.

Bundy *et al.* (*Ann. N.Y. Acad. Sci.*, 1971) described some novel methods for converting the normal PGA to more useful forms such as PGE_2 and PGF_2-alpha. The overall yield of PGF_2–alpha from coral prostaglandins, as per the above workers, was about 15%. Schneider and his associates (*J. Amer. Chem. Soc.*, **99**, 1977) described the isolation and characterisation of (15 R) and (15 S) prostaglandin A_2 from *P. homomalla.* However, (15 R) – prostaglandin A_2 and its acetate methyl ester do not exhibit the biological activities so common in prostaglandins from mammalian sources and their biological role in the gorgonid is also not fully understood at present. Further, the same workers, when they analysed the specimens of the same species from Florida, could get only (15 S) PGA_2 rather than (15 R) PGA_2, previously found to occur in specimens from the Caribbean Sea. In addition to this the Caribbean species contained crystalline PGE_2 (about 0.06%) which is identical in both biological and physical properties to those of mammalian prostaglandin. The above authors have also described several routes for the conversion of these animal products to the primary, biologically more efficient prostaglandin PGE_2 and PGF_2–alpha. The presence of 5, 6-Trans PGA_2 in *P. homomalla,* its separation from PGA_2 and its conversion to 5, 6-Trans PGE_2-alpha are also briefly discussed in the above cited paper. The physiological effects of various prostaglandins, as now understood, are summarised in Table II.

Table 2. *Properties of prostaglandins*

Sl. No.	Potential use	Isomeres	Effects
1.	Birth control	PGF_2–alpha	Reduce progestrone formation
2.	Induced child birth	PGE_2 & PGF_2-alpha	Uterine contraction at low strength
3.	Abortion and induction of menstruation	PGE_2 & PGF_2-alpha	Mechanism not fully understood
4.	Prevention of peptic ulcer	PGE_2 & PGE_2	Inhibits gastric secretion (acid) and pepsin (in Rat)
5.	Treatment of asthma	PGE_1	Relaxes the muscle of bronchial tube
6.	Nasal decongestant	PGE_1	Clears nasal passage
7.	Regulation of blood pressure	PGA_1 & PGE_2	Lowers blood pressure
8.	–do–	PGF_2-alpha	Raises blood pressure
9.	Metabolic regulation	PGE_1	Counteracts the effect of hormones which stimulate metabolism
10.	–do–	PGE_2	Inhibits release of excess epinephrines in response to nerve stimulation.

Terpenoids

Gorgonids are also known to be a rich source of rpenoids. So far about 74 such compounds have been olated from different species and these may be classi- ed under diterpene, sesquiterpene and artifact. Many f the species known from Indian waters are rich in sperdiol, Crassin acetate, Eunicin, Briarein A, isabolene, Cadinene, Corgonene, Copaene, Alloaro- adendrene *etc*.

Our knowledge regarding the origin of these peculiar emical compounds in gorgonids is still meagre. Some e of the opinion that these are produced by zooxan- ellae which grow symbiotically inside the tissue of e gorgonid, while others opine that these chemicals e produced by the animal itself. Many workers have own that the hosts (gorgonid) feed directly on these ooxanthellae which they harbour. This sort of a tro- hic relationship often obscures the precise origin of ese chemicals. Hence there is every possibility that ese chemicals may be produced by the animal, by ymbiotic algae, by the association of both or even by xtraneous source (a dietary origin).

The various chemicals extracted from coelenterates xhibit very interesting bio-dynamic properties. Che- nicals such as Lobolide, Sarcophine, Lobophytollide, rassolide and Africanol are toxic to fish. Antineoplas- ic properties are exhibited by Sinulariolide, Sinularin, rassin acetate, Jeunicin, Eunicin and Africanol.

The ecological significance of many of these spe- ific compounds are not yet fully understood. There ample evidence to show that these terpenoids have a rotective function for the colonies. Sessile colonies ave to protect themselves from both predation and vasion of other micro-organisms, algae, larvae of ther animals *etc*., and these chemicals become so handy their struggle for existence.

ECOMMENDATIONS AND CONCLUSIONS

1. The discovery of prostaglandins in the Caribbean ponge *Plexaura homomalla* (Esper) triggered off a world- ide 'hunt' for the species or its congeners. The pre- ent demand for gorgonids from India, started in 1975, ay be said to be part of this world wide 'hunt' for raw aterials.

2. The total quantity of gorgonids exported from ndia during 1975-'84 was estimated at 36.4 tonnes valued t Rs. 9.9 lakhs. The increasing demand for gorgonids from India by foreign agencies resulted in indiscriminate fishing of this commodity along our coasts and this culminated in the depletion of many of our rich gorgonid beds.

3. At present 22 species of gorgonids referable to seven families and 15 genera are exported from India under four trade names or 'types' such as 'Black', 'Red', 'Monkey tail' and 'Flower'. The above commercial classification is based on colour and growth form, and no genetic affinity is taken into consideration. 'Black' and 'Red' types have heavy demand in the foreign market.

4. Though gorgonids are distributed all along the coasts of India, their presence in fishable magnitude is noted only in the Gulf of Mannar.

5. The absence of any stock assessment prior to the commencement of the commercial exploitation makes the assessment of damage caused to the gorgonid beds by indiscriminate fishing rather complicated. The present work was initiated in 1980 and by that time it is estimated that as much as 25 tonnes have been removed from our beds and this includes a record harvest of 14.7 tonnes during 1978–'79 period.

6. When commercial exploitation of gorgonids started in 1975, the specimens fished out were large so characteristic of any virgin bed and 10–15 of them made one kg, but by 1982 the condition changed drastically and the average size of specimens started showing a decreasing trend resulting in the dominance of smaller specimens numbering 40–45/kg.

7. The above situation, no doubt, affected the price structure of Indian gorgonids in the foreign market. But when some of the importing countries started imposing size regulation at least in a few 'types', it led to a reorientation of our gorgonid fishery in many centres on the following lines: a) fishermen started exploiting new grounds in search of larger specimens and b) fishing exclusively for gorgonids gave place to collections made by fishermen who were primarily engaged in chank or mussel picking, trap fishing and so on.

8. Fishing in new and distant grounds brought in larger specimens initially, but indiscriminate fishing appears to have continued here too, for, during the present investigation it was found that our beds, both conventional and new, were dominated by smaller specimens particularly in some species which were much esteemed in the foreign market. A total ban on the

collection of such species (vide list of species and areas given earlier) would help considerably in restoring their stock position to the original level.

9. To avoid a drastic cut in the quantity of gorgonids exported consequent on the ban on four of the common and widely distributed species in the Gulf of Mannar *(Echinomuricea indica, Gorgonella umbraculum, Heterogorgia flabellum* and *Echinogorgia complexa)* diversification into fishing of other species by (a) enhancing the rate of exploitation of certain other species from Tuticorin (2 species), Keelakarai (3 species) and Rameswaram (2 species) and (b) optimising exploitation at the present level with regard to certain other species at Tuticorin (8 species), Keelakarai (4 species) and Rameswaram (5 species) could also be attempted. Extending the fishing activity to new areas as outlined in the section entitled 'Areas where fishing could be intensified' may also be tried simultaneously.

10. In the case of those species where exploitation has to be optimised at the present level of export, this may be done by fixing a quota for each species. This can be monitored at the present export outlet level by any organisation which is entrusted with such responsibilities.

11. The present survey revealed that gorgonid resources in certain areas would support a healthy fishery in future. Details are given in the section dealing with 'Areas where fishing could be intensified'.

12. At present while harvesting the specimens, they are removed from the substratum and this means total destruction of the colony. This method is unscientific since the colony takes an unusually long period to reach a size of 60 cm in height (approximate rate of growth is 2 cm/year). Also several million larvae are spawned every season by each colony. A complete removal of specimens inhibits the recolonising capacity of our beds. During 1975 to 1984 period a total of 36.4 tonnes of gorgonids have been removed from our beds and the loss of larvae resulting from this could be well imagined. In this context a system to harvest them by cutting and removing parts of the specimen while retaining the basal portion *in situ* to regenerate and reproduce (conservative pruning) should replace the present system of harvest which is rather unscientific.

Since species comprising each type form a polypyletic assemblage of various growth patterns the method of 'pruning' should suit the growth form prevalent in each species. Though this method of harvesting is scientifically sound, the fishermen may find the whole exercise cumbersome underwater. If necessary a type-wise or species-wise method of pruning may be worked out in detail at a later period.

13. It has been found that in a gorgonid colony, 2 cm (average) growth/year amounts to 22% increase in total weight. The weight removed from the stock by fishing every year should not go above this limit to maintain a balanced fishery. Examination of the past years' export figures and observations on the present condition of the beds seem to indicate that fishing had been going on in excess althrough the period and the depletory trend now reflected is the cumulative effect of overfishing going on for the entire period.

In the light of the above findings, the export of this item from India should be restricted to an arbitrary working figure of one tonne annually in future. This quota, if necessary, may be revised every year/season after making an on-the-spot study of the material fished at every centre.

14. It is advisable to fix a minimum size for each species at which their exploitation could be commenced. This will help not only in conserving our resources but also in retaining a sizable fraction of the population for a longer period to reproduce and replenish the beds. This size has to be fixed both species and centre-wise just prior to the commencement of each season after evaluating the fishing pressure of the preceding season/year.

15. *Follow up action:* Barring those species which are here recommended for a total ban on the exploitation, the exploitation of all the other species may go on as per the guidelines provided under the section 'Recent status of our gorgonid beds'.

It is also important to keep a vigil on the harvested material to know whether the suggestions made from time to time are strictly adhered to or not.

16. In the event of extending the fishing activity to any of the virgin areas indicated in the section entitled 'Areas where fishing could be intensified', care should be taken to earmark some selected areas as 'gorgonid reserves.' The natural growth exhibited by gorgonids in these 'reserves' could be compared and contrasted with those in areas where fishing is in vogue for a sufficiently known period. Information of this sort may

give some direct evidence on the problem of human intervention. Further, the gorgonid population in such 'reserves' may help in replenishing the adjacent beds through larvae liberated during every breeding season.

17. India should step up synthesising the various chemicals (prostaglandins, terpenoids and the like) that act as 'wonder drugs' and release them in market without much delay. And for this we have to utilise properly the technical knowhow now available in India. A joint venture may be initiated by pooling the personnel and knowhow available in the various National Institutions, and the Central Marine Fisheries Research Institute, Cochin may be identified as a nodal Institution for the purpose. Further, advanced training, if necessary, may be arranged with foreign laboratories that are competent in these lines.

Speaking revenue-wise this could be a better deal, for the processed extracts *from one tonne of gorgonid can fetch a higher revenue* than what was realised from the export of raw materials for the last 10 years!

18. As a preliminary step in this line measures may be taken to evaluate the chemical composition of the various species available in our waters. The bio-active properties of the various chemicals, thus isolated, may be tested thoroughly and standardised.

19. Species which show encouraging results may be collected and the resource potential may be assessed both in time and space. In case any of these species become scarce, steps may be taken to cultivate them in their natural habitat. It is true that the various chemicals elaborated by them show both seasonal and regional variations and this is why transplantation gives poor results.

20. But, can the overfishing and damage done to the gorgonid stock be staved off? Luckily the stage of no return has not yet been reached and hence remedial measures can still be taken.

Acknowledgements

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We are also very thankful to the authorities of the M.P.E.D.A., Cochin, for providing us the export data presented in Table 1. Finally, we wish to record our sincere thanks to Shri C. Mukundan, Officer-in-Charge, Vizhinjam Research Centre of the C.M.F.R.I., Vizhinjam, for going through the account critically and also for the photographs presented herein.

HOW KVK - TRAINED WOMEN UTILISE THE NEW KNOWLEDGE?*

Introduction

Training of farm women in vocational skills forms an important component of the programmes of Krishi Vigyan Kendra (KVK). The KVK at Vypeenkara in Cochin, Kerala State, attached to the Central Marine Fisheries Research Institute has been conducting courses in fish/prawn culture for farm men and women. The main objective of the programmes has been promoting integrated development of the area through imparting vocational skills with special emphasis on scientific prawn farming. Since its inception the KVK has trained a number of farm women in prawn culture, kitchen gardening, food processing, poultry farming, livestock management, nutrition and social forestry.

A study with the aim of evaluating the utility of the training in prawn farming for women was conducted in 1985–'86. Though evaluation is a built-in component of the programmes of Krishi Vigyan Kendra, its effort has been mainly assessing the overall impact of different programmes. In this study the socio-economic background, motivation pattern and the constraints involved in the utilization of knowledge were examined.

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*Prepared by Krishna Srinath, CMFRI, Cochin.

Material and methods

The Krishi Vigyan Kendra had trained 1,542 women in prawn culture till March, 1985, under its 5-day and 10-day training programmes. Ninetythree per cent of the trained women belonged to Vypeenkara, where the KVK is located and the rest were from other nearby areas. Out of the above population a sample of 300 women, covering different areas, was selected following random sampling procedure. Information on age, education and occupation of the trained women, occupational status of their families, extent of holding, ownership of fishing implements and livestock, motivation pattern, extent of utilization of knowledge and the constraints involved in the same were collected using a specially developed interview schedule.

Results and discussion

Age, education and occupation of trained women

Age and education of the respondents are presented in Table 1. Sixtyfive per cent of the trained women belonged to the age group of 18–25 with education between 8th standard and matriculation. Seven per cent had passed matriculation. One had attended pre-degree course. About 8% of the women had occupations fetching regular income; of them 50% worked as agricultural labourers, 33% were engaged in tailoring and 17% had salaried jobs. The women also earned income seasonally through prawn peeling.

Table 1. *Age and educational status of trained women* (%)

Education	Age				Total
	18	18–25	26–35	36	
Neoliterate	—	1.0	0.3	—	1.3
1–4 Std.	—	1.6	1.0	0.3	2.9
5–7 Std.	1.3	9.6	4.3	1.0	16.3
8–10 Std.	6.3	64.6	0.6	0.3	72.0
Matriculation and above	4.6	2.0	0.1	—	6.9
Pre-degree and above	0.6	—	—	—	0.6

Occupation of the respondents' families

The major occupations of the respondents' families are presented in Table 2. Forty per cent of the families had fishing, 13% had prawn filtration and 15% had other fishery related activities. Thirteen per cent had some salaried jobs and the rest had agriculture as their main source of income.

Table 2. *Details of major occupation of respondents' families*

Occupation	% families
Fishing	40
Prawn filtration	13
Other fishery-related activities	15
Small business and such petty occupations	16
Salaried jobs	13
Agriculture	3

Ownership of holdings, fishing implements and livestock

Sixteen per cent of the respondents' families owned fishing crafts/gears of which 53% was small canoe crewed by two. About ten per cent possessed own and self managed prawn fields. About 20% owned milch animals like cow, buffalo and goat and 28% had hens or ducks (Table 3).

Table 3. *Details of possession of holdings, fishing implements and livestock of respondents' families*

Nature of possession	% families
1. *Prawn filtration field (perennial field)*	
Owned and self managed	2.6
Owned and leased out	1.6
Leased in	1.3
2. *Pokkali field*	
Owned and self managed	7.0
Owned and leased out	3.0
Leased in	2.0
Total	17.5
3. *Agricultural and other holdings*	2.0
4. *Fishing implements (craft/gear)*	16.0
5. *Livestock*	
Milch animals	20.3
Duck and hen	28.0

Motivation pattern

Motivation pattern as given in Table 4 was observed among the trained women. Economic motivation in terms of getting a job ranked first as women thought that taking up a course in prawn culture would help them in getting a job sometime or the other. Affiliation, that is, to be in conformity with the friends was the second important motivator for attending the training programme followed by self achievement and prestige. The nearness of KVK to the village was also an important reason for women to attend the training (Table 4).

Table 4. *Motivation pattern of the respondents*

Motivators	No. of women (N=300)	Rank order
Economic	217	I
Affiliation	86	II
Nearness of KVK to the village	63	III
Self achievement	61	IV
Prestige	15	V
Dominance	—	

Gains of the training programme

The major achievement of the programmes of KVK, especially the training in fish/prawn farming is that it has served as an excellent source of information and propaganda for the scientific prawn farming technology. The trained women had favourable attitude towards Krishi Vigyan Kendra and the prawn farming technology. The programmes of KVK have helped trained women recognise the importance of such a growth centre in the context of area development. Women have gained the ability to identify the larvae of prawns which will enable them in the collection and supplementary/selective stocking which is the first and the most important step in the new technology.

Constraints involved in practicing the technology

The constraints involved in the utilization of the knowledge are presented in Table 5. The rank order of the constraints was finance, lack of suitable holdings, short duration of the training course and other reasons. These findings agree with the results obtained by the KVK in 1985 (*Occupational details of trained farmers as revealed by the follow up survey*-1980 and 1984) which indicated that 49% had finance/lack of suitable holding as constraint.

The improved technology for prawn farming can be considered to be in the early stages of adoption in this area which may lead to wider adoption once there is a regular and assured seed supply from the hatcheries. Unlike in agriculture, women are not generally involved in culture operations excepting for the post harvest peeling and catching the left out fish in the harvested ponds by hand picking. Hence the opportunity for them to work in the farm is limited at present. However, social structure did not bar women from engaging in culture operations.

Table 5. *Constraints involved in the utilization of knowledge*

Constraints	No. of women (N=300)	Rank Order
Financial	262	I
Possess no suitable holdings	247	II
Short duration of the training course	222	III
Risk involved in practicing the technology	183	IV
Being a woman	—	

Regarding practicing the technology in the families' holdings, the following problems were encountered. Only 5% of the respondents' families possessed holdings suitable for prawn culture and traditional prawn farming was being followed in those fields. Those holdings were the joint property of more than one family and did not have documents legalising the possession. Hence the modification of the existing system or lay-out either involved decision making by all who were likely to have the right over the property or brought about lack in initiative in taking up improvement measures. This also led to difficulties in availing institutional credit.

The majority of the trained women belonged to the age group of 18–25 years and at this age are not likely to be involved in decision making. The interest of the women in this age group, as revealed by the study, was getting an employment. The important motivator for women to take up the training, as mentioned earlier, was that this would help them in getting a job in some fisheries organization.

The ability to identify prawn at a very young age has helped women in collection of larvae from the wild for supplementary stocking. But collection of seed from the wild is not recommended of late in view of the conservation of resources.

There was a general feeling among the trained women that the training period was too short for them to gain confidence to venture into the new practice of which they did not have much previous experience. The duration of the course may be sufficient in the case of men as they are directly involved in culture operations. The trained women also opined that it would be more worthwhile to identify and train those women who have the basic infrastructure for taking up the technology.

Suggestions

In the light of the above findings it is suggested that the trainees may be identified based on their needs. To facilitate this, the Kendra may organise women's clubs in the villages and get them enrolled with the Kendra so that the clubs may be asked to sponsor trainees based on the infrastructure available with each member. Such a proposition would also help in taking up the technology on co-operative basis by a group of women and help in availing the facilities offered by other input agencies in easier way. Since the Kendra is offering courses in various aspects of integrated farming the clubs may be able to utilise the benefits more efficiently. Ensuring people's participation through community organisation is one of the pre-requisites for development and approaching women through their own identified groups will help to channalize the Kendra's activities more successfully.

Acknowledgements

The author is grateful to Dr. E. G. Silas, Former Director, CMFRI, for suggesting the problem. Grateful thanks are also accorded to Dr. P. S. B. R. James, Director, CMFRI, for the encouragements in completing the work. Sincere thanks are due to Shri T. Jacob, for his guidance and advice in the execution of the work and preparation of this paper. The help rendered by Dr. M. M. Thomas, Office-in-charge of the Krishi Vigyan Kendra and his associates by providing basic information about the trainees and the training programmes and extending other facilities is also gratefully acknowledged.

A NOTE ON THE HEAVY LANDINGS OF *DIAGRAMMA PICTUM* ALONG THE SAURASHTRA COAST*

During the visit in connection with fishery survey data collection at Mangrol, it was observed on 17–12–1983 that unusually high catches of *Diagramma pictum* (Cuv. & Val.) were landed both by trawl nets and gill nets. Subsequently observations were made at Porbander and Veraval also, where high catches of the same species were recorded. The fishery was of short duration extending for 30 days. Afterwards the catches declined both from the gill nets and trawl nets. The estimated catches at Mangrol, Porbander and Veraval were 401.796 163.608, and 87.475 tonnes respectively. The fishing was conducted at a depth of 40 to 70 metres. The species formed about 46.58%, 16.45% and 1.19% out of total catches at Mangrol, Porbander and Veraval respectively.

The size range of *D. pictum* from the trawl net was 301–650 mm with modal length at 351–375 mm, while from gill nets the size range was 310–660 mm with modal length at 525–550 mm.

Initially the fish fetched a very good price *i.e.*, Rs. 6/- per kg but due to heavy catches the price decreased to Rs. 3/- per kg. The catches were sent to Bombay and Delhi mainly by road.

I am very much thankful to Dr. T. Appa Rao, Scientist S-2, Officer-in-Charge and Shri M. Z. Khan, Scientist S-2 of Veraval Research Centre of CMFRI, Veraval for their help in preparing this note.

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*Reported by Y. D. Savaria, Veraval Research Centre of CMFRI, Veraval.

HIGH LANDINGS OF PRAWN (*METAPENAEUS DOBSONI*) BY PURSE-SEINERS AT PANAJI, GOA*

In Goa the purse-seiners are operated mostly in Panaji, Vasco-da-Gama, Baina, Colva, Cotbona, Betul and Talpona centres. Out of these, Panaji and Cotbona are the major purse-seine landing centres, where the number of purse-seiners exceeds 30 (30-60) and, all other centres have below 15 numbers. The area of fishing is northwest of Panaji-Calangute belt in 20-25m depth zone.

On 19th September, 1984 an unusually heavy catch of penaeid prawns exclusively *Metapenaeus dobsoni* was landed by purse-seiners. This trend continued till 24th September, 1984 (Table). On an average 600-700 kg of prawns were landed by each boat/trip during six days of fishing. Details of catch are presented in Table below.

In the subsequent year also instances of heavy landings of *M. dobsoni* were observed for purse-seines on three occasions (Table).

Prawns were sold at the rate of Rs. 6-12 per kg and an estimated value of Rs. 6,94,016.10 was realised for the prawns caught during nine days of fishing by purse seines.

Date	No. of purse seines operated	*M. dobsoni* (kg)	CPUE (kg)	Estimated value in Rs.
19-9-1984	18	8,535.0	474.17	76,815.00
20-9-1984	22	12,100.0	550.00	1,08,900.00
21-9-1984	22	14,879.9	676.36	1,33,919.10
22-9-1984	24	21,360.0	890.00	1,92,240.00
23-9-1984	22	13,948.0	634.00	1,25,532.00
24-9-1984	18	3,970.0	220.00	35,730.00
6 days	126	74,792.9	593.59	6,73,136.10
16-5-1985	1	1,400.0	—	12,600.00
23-9-1985	1	320.0	—	2,800.00
1-11-1985	1	600.0	—	5,400.00
3 days	3	2,320.0	—	20,880.00

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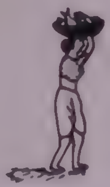
*Reported by G. M. Kulkarni, T. S. Balasubramanian and S. Kemparaju, Field Centre of CMFRI, Goa.



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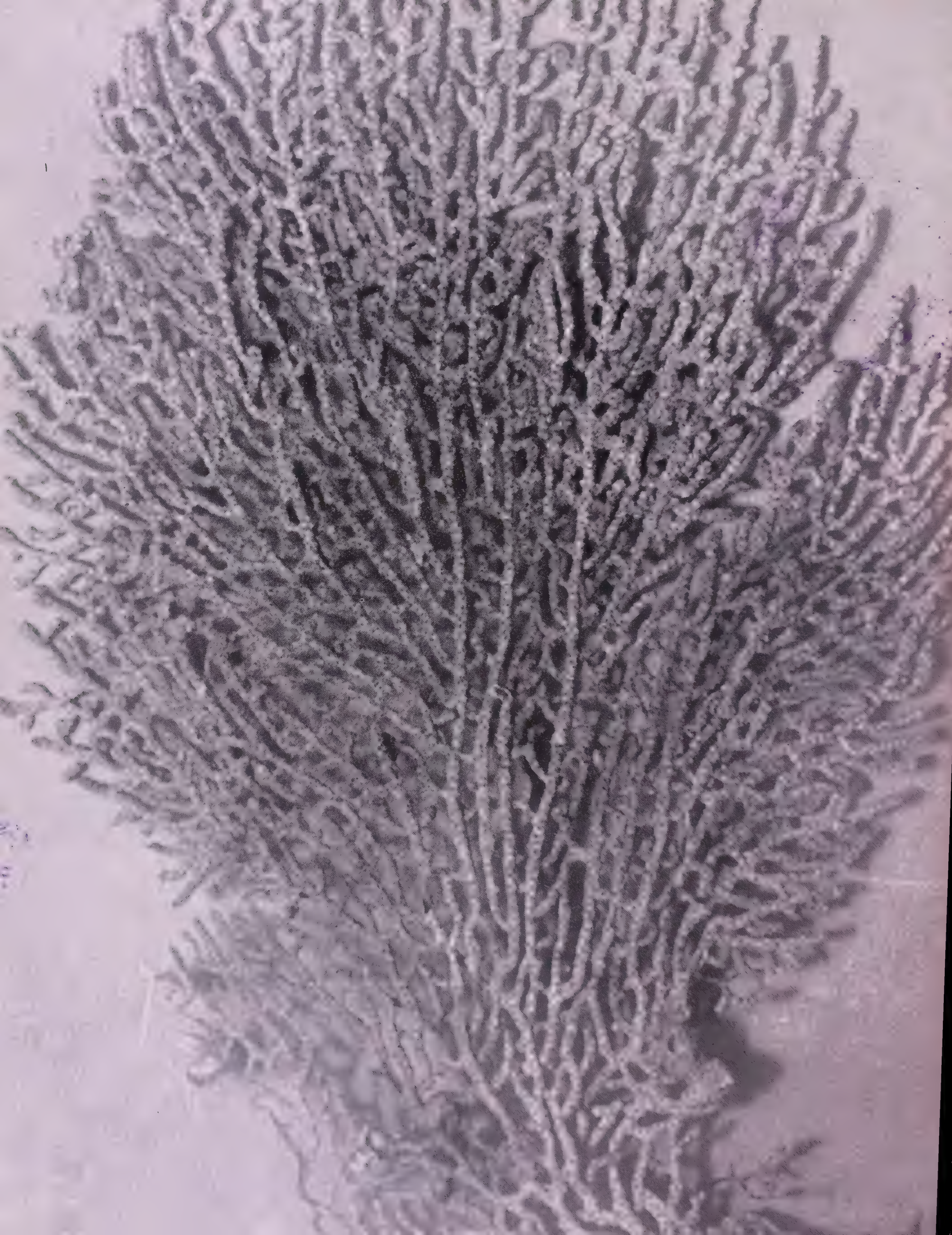

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Front cover photo:

Harvested milkfish and mullet from coastal pond at Tuticorin. Ref: Article No. 2.

Back cover photo:

Fishes, prawns and crabs harvested from a poly-culture farm at Tuticorin. Ref: Article No. 2.

AN INSTANCE OF MASS FISH MORTALITY AT MANDAPAM, SOUTH EAST COAST OF INDIA

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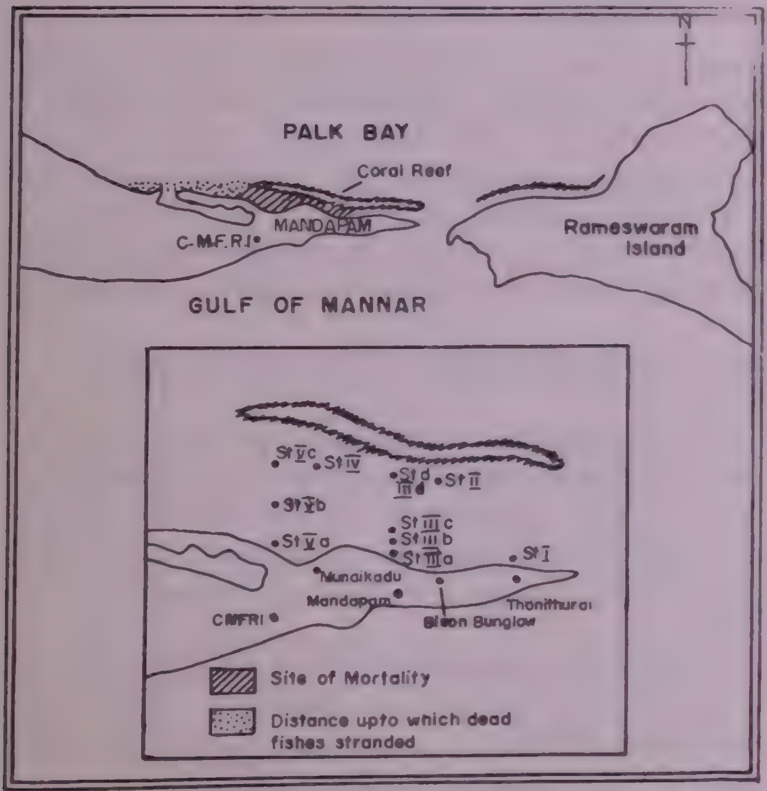
Regional Centre of CMFRI, Mandapam

Location of mortality

A large number of dead and dying fishes and shellfishes was found washed ashore along the beaches of Mandapam on the Palk Bay side in the early hours of 13th May, 1987. This mortality of fishes was restricted to the inshore sea of Palk Bay from Mandapam fish landing centre to about 6 km stretch of the coast towards west and between the seashore and the coral reef on the seaward side (Fig. 1). The open sea beyond the coral reef and the coastal waters east of Mandapam fish landing centre and west of the eastern border of Pillaimadam lagoon were not affected by this phenomenon. However, the dead fishes washed ashore and other organisms were found as far as about 12 km stretch of the coast from the Mandapam fish landing centre towards west upto Theedai fishing village (Fig. 1).



ig. 1. Map showing the site of fish mortality and the stations from where data on hydrological parameters were collected.

The species involved and the impact of mortality

Although an accurate estimate of the quantity of dead fishes and shellfishes was not available due to the removal of dying or dead fishes by the local people immediately after the occurrence of the incidence, it was estimated that about 2–3 tonnes of fishes might have been killed by the phenomenon. About 20 species of important fishes (Figs. 2 & 3) including some of the commercial species, two species of crabs, molluscs such as *Sepia* spp., *Loligo* spp., *Aplysia* spp. and *Donax* sp., and alphied shrimps were found affected (Table 1). Among the dead fishes, *Epinephelus* spp., *Lethrinus* spp., *Siganus* spp., *Platycephalus* spp., *Psammoperca waigensis*, *Therapon* sp., *Apogon* sp., *Plotosus* sp., *Muraena* spp. and *Gobius* spp. were abundant and among crustaceans the blue swimming crab *Portunus pelagicus* was the principal species. Besides these fishes and shellfishes, an appreciable number of juveniles of *Siganus* spp., *Gerres* spp. and *Epinephelus* spp. was also found washed

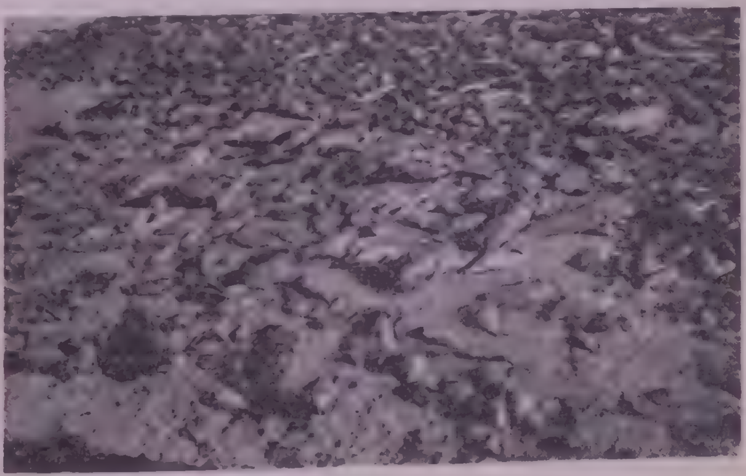


Fig. 2. A view of the dead fishes washed ashore at Mandapam on 13-5-1987.

CMFRI, Cochin.

ashore. The size range of the different species is given in Table 1.

Table 1. *List of dead fishes and shellfishes collected from the area of fish mortality at Mandapam during* 13–15 *May,* 1987

	Species	Size range (mm)
	FISHES	
* 1.	*Epinephelus* spp.	80–520
* 2.	*Psammoperca waigensis*	200–270
* 3.	*Platycephalus indicus*	300–400
* 4.	*Lethrinus* spp.	210–300
* 5.	*Hilsa kelee*	160–200
6.	*Holocentrus* spp.	120–160
7.	*Chaetodon* spp.	75–150
* 8.	*Plotosus* spp.	65–175
* 9.	*Siganus* spp. (adult)	200–300
10.	*Siganus* spp. (juveniles)	30– 45
11.	*Tetrodon* spp.	150–350
12.	*Muraena* spp.	600–700
13.	*Gobius* spp.	70–135
14.	*Sparus* spp.	20– 35
15.	*Apogon* spp.	45– 80
16.	*Diodon* spp.	300–350
17.	*Abudefduf* spp.	110–115
18.	*Chromis* spp.	90– 95
*19.	*Liza waigensis*	300–350
20.	*Pseudopristipoma niger*	100–150
*21.	*Arius dussumieri*	400–600
*22.	*Amphotistus kuhlii*	200–350
	CRUSTACEANS	
*23.	*Portunus pelagicus* (Measurement across carapace)	40–140
*24.	*Scylla serrata*	41–160
25.	*Alphaeus* spp.	80– 90
**26.	*Penaeus* spp.	—
	MOLLUSCS	
*27.	*Sepia* spp.	60–80
*28.	*Loligo* spp.	—
29.	*Aplysia* spp.	—
30.	*Donax* spp.	—

* Commercially important forms
** Very rare

The species composition of the dead fishes indicated that most of the species affected by the phenomenon were those inhabiting near the bottom or the reef-dwelling fishes. It was noteworthy that neither prawns nor the pelagic fishes were found among the affected population. Some of the fishes such as juveniles of *Epinephelus* and gobids and crabs were seen congregating near the shore in a semi-conscious state gasping for air, even after two days of the incidence. An examination of the gills of these fishes revealed that they were either light red or reddish. The gills of the dead fishes were covered with sand. No abnormal conditions such as excessive slimy nature or blackish discolouration or parasitic infestation were observed. The stomach content analysis of the dead fishes such as *Epinephelus* sp., *Siganus* sp., *Lethrinus* sp., *Platycephalus* sp., *Holocentrus* sp. and *Chaetodon* sp. showed that the gut was devoid of any food in all the cases except in one specimen of *Epinephelus* sp , which contained an undigested *Therapon* sp.

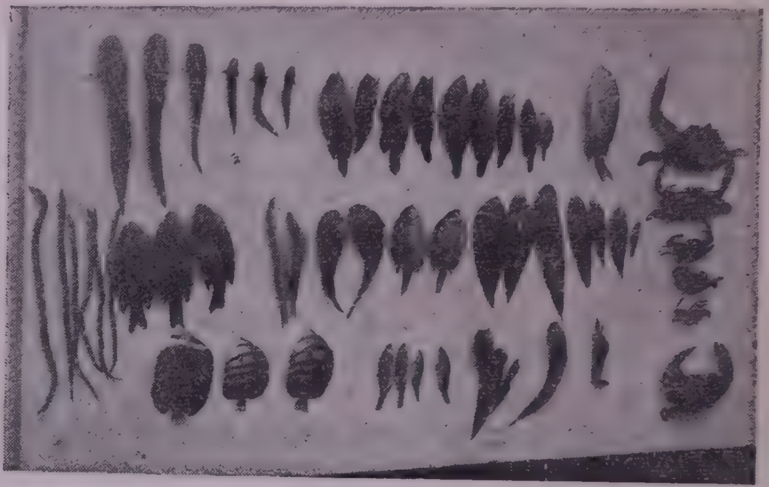


Fig. 3. Some of the principal species of fishes and shellfishes affected by the mortality reported on 13–5–'87 at Mandapam.

The environmental features of the affected area

The inshore sea of Mandapam during the reported period of mortality was calm. There was also no strong wind normally prevalent in the area but the water in the affected area appeared turbid and murky. The bottom soil at patches was found to be black.

Data on hydrographic features such as temperature, pH, salinity, dissolved oxygen, phosphate, silicate, nitrite and nitrate collected from different regions of the affected and the adjacent unaffected areas during 13–22 May, 1987 are given in Table 2. The surface water temperature during 13–15 May following the incidence, varied between 31.5 and 31.8°C while the pH showed a range of 8.0 to 8.2. The salinity of the surface water

Table 2. *Ecological features of the inshore area of Mandapam on the Palk Bay side during 13–22 May, 1987 immediately after report of mass mortality of fish*

Date	Station	Distance from the shore (km) and depth of the station (m)	Surface temp. (°C)	Salinity (‰)	Dissolved oxygen (ml/1)	pH	Phosphate (µg-at/1)	Silicate (µg-at/1)	Nitrate (µg-at/1)	Nitrite (µg-at/1)
13–5–'87	I	Intertidal	—	S 33.79	5.82	8.2	0.05	18.0	1.75	0.74
	III a	0.03	31.8	S 33.28	0.94	8.0	0.05	21.0	1.0	0.84
	V a	Intertidal	—	S 34.81	3.58	8.0	0.05	18.0	1.0	0.84
14–5–'87	II	1/4	31.5	S 33.29	2.28	8.0	0.05	21.0	0.25	3.15
				B 32.51	1.50	8.0	0.13	22.0	7.75	6.30
	III d	1/4	31.8	S 32.02	1.09	8.0	0.18	24.0	6.50	1.05
				B 33.79	0.78	8.0	—	—	—	—
	IV	1/4	31.5	S 33.79	1.71	8.0	0.05	30.0	0.25	1.89
				B 32.76	1.91	8.0	0.05	25.0	0.50	0.21
	V c	1/4	—	S 33.54	2.34	8.0	0.07	21.0	0.25	0.21
15-5-'87	III b	0.2/1	31.5	S 31.70–32.00	0.21–0.26	8.0	0.75–1.50	14.0–17.0	4.25–9.78	5.88–12.18
					B 0.00	8.0	—	—	—	—
	V b	0.5/3	—	S 34.87	2.60	8.0	0.70	18.0	9.25	12.39
					B 2.08	—	—	—	—	—
20–5–'87	III a	0.5	—	S 32.00	0.94–1.18	7.79–8.00	0.40–0.45	9.0–16.0	0.25–1.00	0.84–1.68
	b	1.0	—	S 31.5–32.00	1.23–1.30	7.76	0.40–0.48	21.0	0.25–0.37	0.63–1.89
	c	2.0	—	S 31.5–32.0	1.43–1.58	7.63–7.79	0.35–0.43	14.0–24.0	0.25–1.00	0.42–0.63
22-5-'87	III a	0.5	—	S 31.5–32.0	1.79–3.32	8.0	0.40	4.0–6.0	0.25–0.37	0.21–0.32
	b	1.0	—	S 31.5–32.0	3.06–3.37	8.0	0.40	5.0–5.5	0.25	0.21
	c	2.0	—	S 32.0	3.12–3.17	8.0	0.40–0.45	4.0	0.25	0.21

Station I: off Thonithurai; II: off Bison Bungalow; III: off Mandapam fish landing centre – Marakayar Boat Yard; IV: off Munaikadu; V: off Fish Farm of RC of CMFRI.

at different stations ranged between 31.7 and 34.8‰. The dissolved oxygen values of the surface water in the affected area were found between 0.21 and 3.58 ml/1, while near the bottom, it varied from nil to 2.08 ml/1. In the open sea (about 1 km from the shore) and also n the unaffected area (Station 1), however, the dissolved oxygen was at 4.37 ml/1 (off Dhargavalasai) and 5.82 ml/1 respectively.

While there was not much variation in the tempera- ure and salinity values during 13–15th May and the following days, the dissolved oxygen values of the seawater in the affected area showed gradual improvement and reached normal conditions by about 22-5-'87, *i.e.* after a week of the report of mass mortality of fishes.

The data on phosphate, silicate, nitrite and nitrate concentration of the seawater during the affected days (13–15 May) showed variation between 0.05 and 1.50; 14.00 and 30.00; 0.25 and 9.78 and 0.21 and 12.39µg at/1 respectively (Table 2). Relatively higher values of these nutrients were observed immediately after the incidence.

The above ecological features indicated that while the temperature, pH and salinity of the waters in the affected area were within the normal range reported earlier, the dissolved oxygen was found highly depleted registering nil values, particularly in the inshore region between the coral reef and the shore. Similarly, although higher values of nutrients were recorded in the water samples collected on 14th and 15th May, the data were found comparable with those recorded in the corresponding period of the previous year and those of the previous month from the adjacent region.

The phytoplankton samples collected on 13–5–'87 from the affected and the adjacent unaffected areas showed the common diatoms such as *Nitzchia* sp., *Pleurosigma* sp. and a few filaments of *Oscillatoria salinarum*. Toxic forms were not present. The sample collected on 14–5–'87 showed the dominance of diatoms represented by the species of *Coscinodiscus, Chaetoceros, Rhizosolenia, Nitzschia, Asterionella, Pleurosigma* and *Synedra*. A few forms of dinoflagellates such as *Ceratium* spp., *Peridinium* spp., *Diplopsalis* spp. and *Prorocentrum* spp. were also present. *Trichodesmium thiebautii* formed the exclusive species of the phytoplankton collected on 15–5–'87. Similarly, the pennate diatom *Nitzschia sigma* var. *indica*, constituted the principal species of the phytoplankton of 19–5–'87· These observations indicated that although no actual phytoplankton bloom was observed on 13th May when the incidence was first reported, blooming of *T. thiebautii* and *Nitzschia sigma* var. *indica* respectively were seen on 15th and 19th May in the affected area. Further, isolated observations on phytoplankton blooms near Mandapam on the Gulf of Mannar side in the last week of April showed blooms of *Trichodesmium* sp. on 6–5–'87 in the inshore waters off Keelakarai and discolouration of seawater from the normal from off Mandapam and Devipattinam on 9th and 10th May. However, there was no record of any fish mortality on these days. Zooplankton biomass was generally poor. It was composed of copepods, *Evadne* sp., fish larvae and a few fish eggs.

The possible causes of the fish mortality

Although no large scale industrial or domestic effluents polluting the sea were observed in this region, the disposal of unsold and rejected fishes and washings from the fish curing tanks into the sea at the Mandapam fish landing centre on the Palk Bay side where over 250 mechanised vessels are based and land their catches, were found to affect the water quality of the sea at this centre. During the period of the incidence, the inshore sea at this centre was found murky, emanating constant bad smell of hydrogen sulphide. The bottom soil was also found to be black. This polluted water was found to get mixed up with the adjoining open sea water. Besides, it was reported that small quantities of untreated effluent were also occasionally discharged into the sea by the Pamban road bridge construction authorities.

On the basis of the above information and the data, it appears that the cause of fish mortality observed between 13th and 15th May, 1987 at the Palk Bay side of Mandapam was mainly due to the natural phenomenon resulted by the ecological changes restricted to an area of about 3–4 km^2 between the shore and the coral reef. It was possible that the phytoplankton blooms reported just before the phenomenon and its isolated occurrence immediately after the incidence, and the associated changes in the water quality, the mixing up of the polluted water drained from the Mandapam fish landing centre and its subsequent spread within the reef area due to the prevailing water current would have triggered off an anoxic condition in the water column causing stress in the environment and consequent mortality of the fishes. Such occasional mortality of fishes and ecological disturbances have been reported from this region earlier by Chacko (1942), Chidambaram and Unni (1944), Chidambaram and Kurien (1952), Prasad (1953), Chacko and Mahadevan (1956), James (1972) and Nammalwar and Narayanan (1979). The facts that only the reef dwelling and bottom living fishes were affected by the phenomenon and that there was no mortality of either the pelagic fishes or the fishes living outside the reef indicated that the impact of the incidence was confined within the reef and the shore. The same reason rules out the possibility of mortality caused by the incursion of oxygen depleted waters into the area. Further, the absence of any physical and biological symptoms as revealed by the examination of the dead fishes, their gills and the gut contents, and the absence of any report of untoward incidents on the consumption of the dead fishes excluded the possibility of the cause of the reported mortality due to poisoning, pollution or the use of explosives.

Remarks

There was an initial hesitation among the local people to collect the gasping fishes near the shore and those washed ashore for consumption/marketing due to the suspected cause of the mortality by poisoning. Subsequent to the allay of this fear, however, both fishermen and local people gathered these fishes, sun dried or used for fish meal. As there was little demand locally, an appreciable quantity was transported for marketing elsewhere in places such as Madurai, Trichi and Kerala.

It is interesting to note that the recovery of the affected area to the normal condition took nearly a week. This might be due to the reef-protected nature of the area, weak water movement within the reef and absence of strong wind during the period.

The constant guidance and encouragement afforded by Dr. P. S. B. R. James, Director, C.M.F.R.I. are gratefully acknowledged. Thanks are also due to Dr. C. P. Gopinathan, Scientist S-2, Research Centre of Central Marine Fisheries Research Institute, Tuticorin for identifying the phytoplankton.

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CULTURE OF FIN FISHES ALONG THE COAST OF TAMIL NADU

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Introduction

Countries bordering the Indian Ocean have had a long history of experience in the cultivation of aquatic organisms and thus form important centres of aquaculture in the world. In India too such traditional culture practices have been well established in many maritime States. While in many states, these have undergone rapid development, in Tamil Nadu the coastal aquaculture remained largely at subsistence level almost as it was in the distant past though the potentials for its development are great. Small-scale experiments at various centres have demonstrated the possibilities of successful salt water fish farming.

As early as in 1911, Hornell proposed the possible conversion of various types of coastal areas like lagoons, mudflats and hypersaline channels for fish production. Possibilities for coastal fish farming have been revealed by the pioneering works of Tampi (1960), Chacko and Abraham (1962), Evangeline (1967) and Nair *et al.* (1974) with the culture experiments carried out at Mandapam. In recent years the research centres of Central Marine Fisheries Research Institute and the Fisheries Department, Tamil Nadu have made series of attempts in different parts of the State to improve the existing culture practices in the country and to develop new indigenous techniques to establish fish farming on scientific and modern lines. Considerable progress has been achieved in this direction. Mention has to be made to the works of Dorairaj *et al.* (1980), James *et al.* (1980a, 1980 b), Marichamy and Rajapackiam (1982), Marichamy *et al.* (1980), Venkataraman *et al.* (1980) and Shanmugam and Bensam (1980) which were carried out in the marine environment. The problems and prospects of salt water fish culture in Tamil Nadu were reviewed by Tampi (1967, 1969, 1972), Krishnamurthy (1972), James (1980) and Srinivasan *et al.* (1980). In the coastal aquaculture sector, the main objective is to achieve high production through improved culture practices involving selective stocking and intensive culture including the practice of polyculture, and development of hatcheries for high priced species. The present account compiles the information now available with regard to resource potential, site development, methods of culture and management techniques and examines the scope for large scale expansion of this sector.

Resources

Tamil Nadu possesses the essential basic resources of water, land and cultivable species required for immediate development of mariculture. A variety of marine fishes possessing high reproductive capacity, short larval development, fast rate of growth and physiological features to adjust to wide changes in the environment are available along the coast of the state. The sources for the collection of seed of most of the important groups have been studied and the potential grounds identified (Renganathan and Ganapathy, 1949; Panikkar *et al.*, 1952 ; Krishnamurthy, 1972). Tampi (1973) while listing the fry collection centres and seasons of collection, estimated that a total of at least ten million fry and fingerlings of *Chanos* could be collected from coast of Tamil Nadu in a year. More recently, the Central Marine Fisheries Research Institute carried out a project on the survey of seed resources of southeast coast of India. The fisheries department of the state had organised special collection drives in certain years besides the regular fry collection centres. All these have revealed the potential and possibilities for better exploitation, eventhough a quantitative assessment in terms of effort expended is yet to be prepared for a more precise picture.

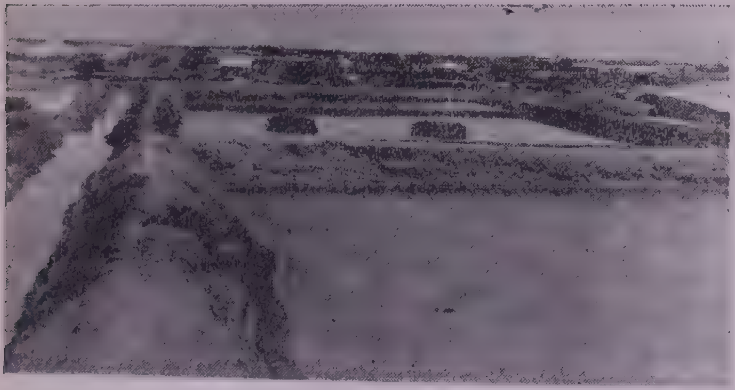

Fig. 1. The CMFRI fish farm at Karapad, Tuticorin.

Among the culturable marine fishes the milkfish *Chanos chanos* is widely selected and the best period for large scale collection of their fry is generally the summer months March–July, although a secondary spawning of this species during September—November has also been reported in some parts. Next to milkfish, mullets constitute a group of great importance in coastal fish culture, particularly the species *Mugil cephalus, M. waigiensis, M. seheli, Liza parsia* and *L. macrolepis.* They occur in the same habitats along the coast with *Chanos* fry and have a peak season during northeast monsoon period. The potential grounds for the collection of fry of these fishes are the areas of Pulicat, Ennore, Adayar, Muttukad, Kadappakkam, Marakkanam, Cuddalore, Parangipettai, Killai, Thirumalaivasal, Tranquebar, Nagore - Nagappattinam, Point Calimere, Muthupet, Adirampatnam, Theedai lagoon in Mandapam Camp, Chinnapalam creek of Pamban islands near Mandapam, Valinokkam, Tuticorin, Pullavahi, Palayakayal, Pinnakayal, Tiruchendur and Colachel. Besides these promising species, culture of the pearl spot *(Etroplus suratensis)*, bhekti *(Lates calcarifer)*, threadfins *(Polynemus indicus, Eleutheronema tetradactylum)* and *Anguilla bicolor bicolor* has gained importance in recent years.

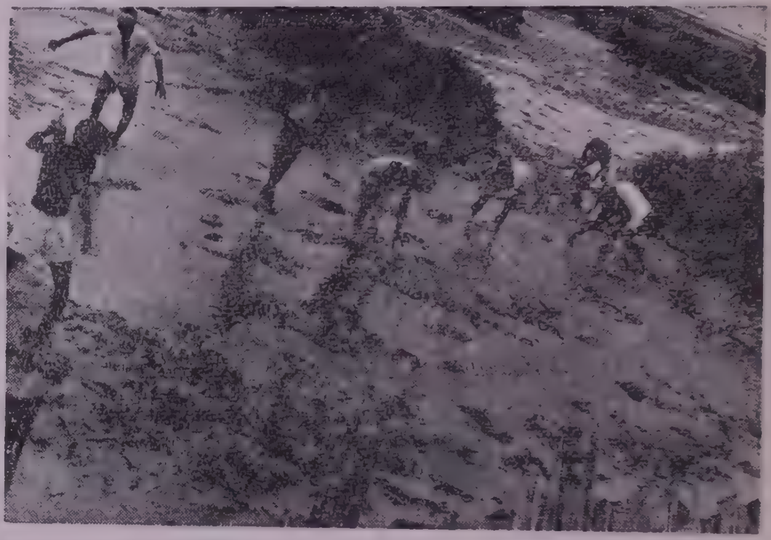

Fig. 2. Harvesting the cultured fishes after draining.

Experimental culture of sandwhiting *Sillago sihama* has indicated that it is a good species with good potential. The other cultivable species are *Elops indicus, Therapon* spp., *Epinephelus* spp., *Siganus* spp., *Megalops cyprinoides* and *Tilapia* sp. The occurrence of fingerlings of *Sillago sihama* in good quantities in May and October in the tidal reaches of Pillaimadam area near Mandapam has been reported by the scientists of Central Marine Fisheries Research Institute (James *et al.*, 1980 c). Several collection grounds of elvers in the river mouths along the southeast coast have been located.

The potential coastal waters available for culture in the State, estimated to be 0.080 million ha include estuaries, creeks, canals, tidal flats, backwaters, brackishwaters, lakes and saline swamps besides the productive space in inshore waters for open sea farming. The most important consideration is the location of the site in relation to the tidal amplitude. The tidal amplitude is poor in most parts of the State and therefore the location of the farm should take maximum advantage as regards the level of the ponds and supply channels. Availability of a source of freshwater would be an added advantage in controlling wide variations in salinity and temperature. The soil of the pond has a direct bearing on the productivity of the ponds. A clayey soil rich in organic matter encourages the growth of various micro-organisms which become the food of fishes. Such soil is impermeable to water and can be used to form a firm, leakproof bund which is not easily eroded by wave or tidal action. The vast tidal mud flats available in Valinokkam, Tuticorin, Pullavahi, Palayakayal and Pinnakayal are such grounds in Tirunelveli District available for immediate development, and already farming works are in progress in certain spots.

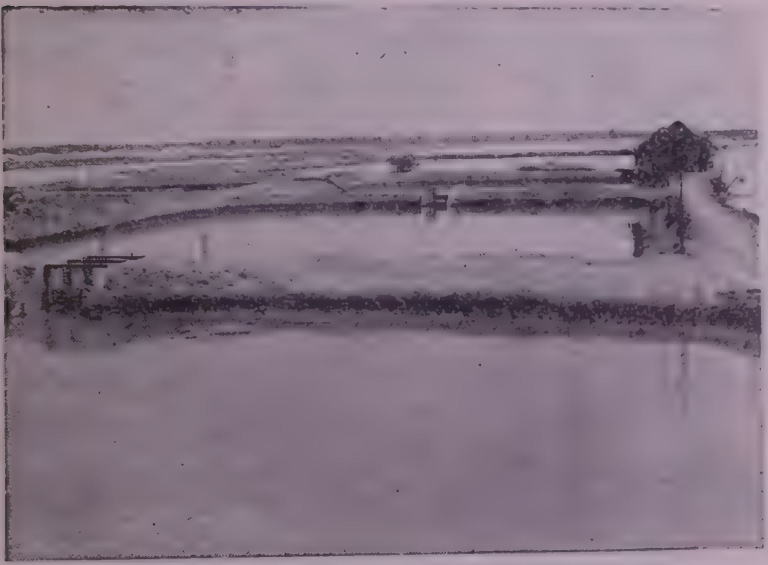
Fig. 3. Fish culture ponds in salt pan area at Veppalodai, Tuticorin.

Besides the development of such derelict areas for coastal aquaculture, another system of culturing also can be developed in salt pan reservoirs around Tuticorin and Manakudy. Some private farmers have already initiated culture projects in these areas.

Varma *et al.* (1963), Nair *et al.* (1974) and Marichamy *et al.* (1980) have described the optimum hydrological factors required for the different culture systems. According to them the salinity of the rearing media in the range 10–40‰ would be ideal for the fast growth of various fishes. Higher and lower pH are detrimental to the health of fishes and the optimum value would be around 8.00. Dissolved oxygen content at the level of 3.5 ml/1 and above is the required condition.

Present status of culture practices

Mariculture of fin fishes can be broadly classified into two categories *viz.*, extensive and intensive methods. chiefly according to the ecosystem and species selected for culture. Extensive fish farming consists of just holding, growing and harvesting fishes in impoundments, whereas intensive culture involves selective stocking of the ponds with fish fry obtained from natural sources or hatcheries and raising them under controlled conditions. The extensive system of culture is represented by the traditional coastal aquaculture practices of the country, such as 'Bheries' of Sunderbans in West Bengal, 'Pokkali' fields of Kerala and 'Gazan' of Karnataka. In Tamil Nadu, the existing system of culture practices followed in low saline salt pan reservoirs of Tuticorin and Manakudy, though not prominant, may come under the extensive category. Realising the great scope for salt water fish farming, a series of experiments are now being carried out at different places of the State.

Intensive culture practices vary widely. Floating rafts with net or cages are preferred for the culture of large sized fishes like *Lates calcarifer, Polynemus* spp., *Epinephelus* spp. and *Caranx* spp. The Fisheries College, Tuticorin has started a project on this and the work is in progress. In places where the coastal currents are poor, net enclosures and pen impoundements in shallow regions of the coastal zone are other choices of mariculture. Preliminary experiments have been carried out at Mandapam Camp and Tuticorin by the Central Marine Fisheries Research Institute with different species. Combined culture of compatible species of fin fishes is gaining considerable importance as a means of effective utilisation of all the available ecological niches of the culture system. The mullets, milkfish and prawns together were profitably cultured in ponds. The growth and survival rates were good in the combination of mud crab *Scylla serrata* and *Chanos chanos* in ponds. The period of culture varies from 8–10 months. The development of coastal fish farm including the site selection, pond construction, water characteristics, farm management and results have been described by Marichamy *et al.* (1980).

The results of the culture operations carried out along the southeast coast of India in the marine environment are presented in Table 1. Variations with respect to growth, survival and production rates have been noticed and attributed to ecological and biological factors. Better results were attained in polyculture systems. Although the cultured species are euryhaline, the higher salinity retards the growth of the stock. Unfertilised ponds and the predation problems also cause poor production rate.

As regards eel culture, elvers have been found to grow fast under controlled conditions in running fresh water systems and attain marketable size at the end of one year. They feed on a variety of fishes and clam

Table 1. *Results of fish culture experiments carried out along the coast of Tamil Nadu*

Place	Culture		Species	Growth rate (mm)	Survival (%)	Production (kg/ha/yr)	Authors
	System	Methods					
Krusadai	Monoculture	Ponds	*C. chanos*	235–240/yr	—	—	Chacko and Mahadevan (1956)
	Monoculture	Ponds	*C. chanos*	240–250/yr	—	—	Menon *et al.* (1959)
Mandapam	Monoculture	Ponds	*C. chanos*	300 ,,	9–11	212–455	Tampi (1960)
Veppalodai	Polyculture	Ponds	*C. chanos*	333 ,,	50	192	Marichamy and Rajapackiam (1982)
			M. cephalus	420 ,,	20	362	
Tuticorin	Polyculture	Ponds	*C. chanos*	300–378 ,,	5	324	Marichamy *et al.* (1980)
			L. macrolepis	211–240 ,,	67	630	
			S. serrata	130-175 ,,	26	690	
Mandapam	Monoculture	Tanks	*A. bicolor bicolor*	23/m	98	22/m	Dorairaj *et al.* (1980)
Mandapam	Monoculture	Cages	*S. canaliculatus*	8.5 ,,	60	—	James *et al.* (1980b)
			S. javus	6.2 ,,	40	—	
			E. tauvina	25 ,,	75	—	
			S. sihama	10 ,,	—	—	
Mandapam	Monoculture	Pen	*V. seheli*	25 ,,	—	—	James *et al.* (1980a)
	Polyculture	Ponds	*L. macrolepis*	13 ,,	—	—	
			C. chanos	17 ,,	—	—	
			P. indicus	9.4 ,,	—	—	
			S. sihama	11.4 ,,	—	—	
Mandapam	Polyculture	Pen	*Mugil* sp.	18 ,,	70	—	Venkataraman *et al.* (1980)
			C. chanos	50 ,,	50	—	
Tuticorin	Polyculture	Pen	*C. chanos*	27 ,,	5–48	damaged	Shanmugam and Bensam (1982)
			Mullet	23 ,,	—	—	
Tuticorin	Monoculture	Ponds	*C. chanos*	44 ,,	318–857	—	Bensam and Marichamy (1982)

meat. A pilot project covering survey of elver resources, collection and transportation of elvers, exportation of live elvers and culture of eels was completed by the Central Marine Fisheries Research Institute with the financial assistance of the Marine Products Export Development Authority. A number of private fish farmers have already started small-scale marine fish culture along the coast of Tamil Nadu. The CMFRI has started projects for large-scale development of fish farming in 90 ha area at Muthukad and 500 ha in Theedai lagoon at Mandapam Camp.

Culture management

The results of the culture experiments are encouraging. The areas which require further research inputs have also been identified, particularly in respect to the development of hatcheries for large scale production of fish seed, nutrition of culture fishes, control of diseases and predators, induced maturation in captivity, methods of culture and coastal farm engineering. All these need-based intensive programmes have been started by the central and state fisheries departments located in different centres of the State.

Careful considerations on the following aspects are necessary before farming the sea edge such as (1) the topography and tidal regime of the area, (2) soil and water characteristics, (3) presence of required seed resources in the surroundings, (4) the fauna and flora as well as environmental parameters of the area and (5) legal regulations and the socio-economic conditions of the locality. Efficient farm management involves the preparation of pond, maintenance of water condition, fish population management, production and maintenance of natural food, supplemental feeding, control of pests and predators and effective harvesting.

The development of such sea-farming largely depends upon the effective transfer of the technology developed and this can be effected through training programmes, including demonstrations, special courses of summer institutes, consultancy services and regular courses of Krishi Vigyan Kendra, on such aspects of mariculture techniques regarding seed production, farm operations, simple harvest technology, farm management, marketing and economics.

Future lines of work

Mariculture has gained importance and as such the schemes relating to its development are included in the current five year plan. The employment potential in seafarming is enormous as Tamil Nadu is endowed with several protected bays, lagoons, vast estuarine and brackishwater areas which could be converted to fish farms. Developmental supports should be made available for converting these areas into fish farms. Farm engineering for marine aquaculture is a new field and it is essential to develop new designs and innovative techniques for constructing bunds, sluices and feeder canals to suit the local conditions. Continued investigations are needed for the development of low-cost technology for intensive culture of more suitable species in different ecological systems as well as the survey of seed resources in new sites. Formulation of suitable feed mixtures using low-cost ingredients with high conversion ratios will be another priority area of research for expansion of the industry. The methods developed in recent years have been largely empirically determined and can probably be improved. The methods of fertilization should be tailored to soil and water chemistry. Extensive experimental studies in using organic and inorganic fertilisers for enriching the ponds is a line of work to pursue. The practice of continuous stocking and harvesting with a year-round growing season as done in Taiwan will result in good yield. The venture of fish culture should be organised on co-operative basis at cottage industry level. A practical system to produce the seed of desirable species on a large scale under controlled conditions has not been developed so far. Improvement of present collection methods could be made based on the behavioural characteristics of the species. The use of scare-line in shallow tidal creeks would be the effective gear for good catches. Also, conservation measures should be introduced since a lot of *Chanos* fry are collected and spoiled by children in coastal villages without realising the immense value of this resource. Besides exploring the unexploited stocks, the ultimate solution must be the breeding of milkfish and mullets in captivity.

With such high seed production, there could be chances to export the *Chanos* fry and develop fry trading centres. Fish fry collection and fry trade can develop into a very profitable supporting industry. Government must make derelict marshy areas and coastal lagoons available to enterprising societies of fish farmers on long-term lease, besides the development of credit and marketing schemes. Provision of model farms and extension services by Government departments on modern scientific lines as technical guidance and training will promote this growing industry. Schemes on the pattern of Fish Farmers Development Agencies established in Tanjore District, should be set up for the implementation of fish culture in sea-base, involving local fishermen. Full support from Government in the beginning can be given particularly to train the fish farmers. Local fishermen may prefer this part-time avocation. The National Commission on Agriculture has recommended that maritime states should undertake a detailed survey of brackishwater fish farming and establish pilot commercial fish farms. Future work should be centred around this scheme for further extension.

Problems

The land leasing policies do not permit long term aquaculture practices. Credit facilities for commercial scale expansion are lacking. Constraints on technological inputs are many. Reclamation of saline water areas is an arduous task. Fast industrial advancements along the shore, particularly the chemical and fertilizer plants, may pose a problem with their discharges, and it would adversely affect the development of coastal aquaculture. The need for protecting aquaculture areas from the effects of pollution is stressed for the trouble free progress of culture projects. The preparation of inexpensive supplementary or complete feeds from locally available ingredients is another development that is required for intensifying culture operations. Reliable techniques for the proper improvement of derelict lands and management of farming along the sea shore are other problems to be solved.

Remarks and conclusions

It is understood from our planning reports that if our brackishwaters are fully utilised, about 31 lakh tonnes of fish could be produced every year and about 28 lakhs people will be able to get employment opportunities. This will be increased if the edge of the sea is farmed for fish culture practices. The species used in culture system have high unit value, besides other benefits. Even if 10% of area of the available coastal lands is brought under culture by scientific methods, the production can be increased considerably.

Fish farming along the coast has a direct bearing on the coastal rural economy, in that it will provide opportunities for self employment, increase production of cultivable marine fishes several-fold, support a number of ancillary small-scale industries, provide material for export and bring about an overall improvement in the socio-economic conditions of coastal fishermen and farmers. The fishermen have plenty of leisure time during off season which could be effectively utilised in farming work. The mariculture system combining with traditional fisheries must be selected on consideration of several factors relating to the technical aspects of culture as well as socio-economic aspects of the fishermen community. Culture methods of proven techno-economic feasibility, developed by research institutes, have been transferred to some extent by different means like operational research projects and demonstration programmes in different parts of the country, including Tamil Nadu. Training programmes in coastal aquaculture have been developed through Krishi Vigyan Kendra of ICAR and the establishment of such centres in the State may benefit much. In the initial stages subsidies and loans will have to be provided as was done in the case of mechanised fishing. The service of the technical experts of the fisheries research institutes coupled with active participation of the planners, administrators, financial agencies and the fish farmers with the available basic resources is the urgent need for the rational development of farming the sea edge.

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BEACH EROSION AT KOVALAM FISHING VILLAGE, TAMIL NADU, WITH SOME COMMENTS ON THE SEASONAL SHIFTS IN THE COASTLINE ALONG THE KOVALAM BAY*

Introduction

Kovalam village (Lat. 12°46′; Long. 80° 18′), 36 km south of Madras city, is a small hamlet overlooking the southern end of the picturesque bay (Fig. 1). The main settlement, consisting of thatched, as well as 'pukka' houses, is located very close to the sea on a sand mound of 2 m high. These houses were hidden behind a thick grove of coconut palms (Fig. 2) until calamity in the form of severe sea erosion struck the village during May–June, 1986. Over 150 coconut palms and 13 houses were destroyed (Fig. 3 & 4) and several others damaged severely, affecting the livelihood of many households. Temporary relief came in the form of piles of sand bags (Fig. 5) to prevent further damage. The sea receded by the last week of June and there was no further threat to the village.

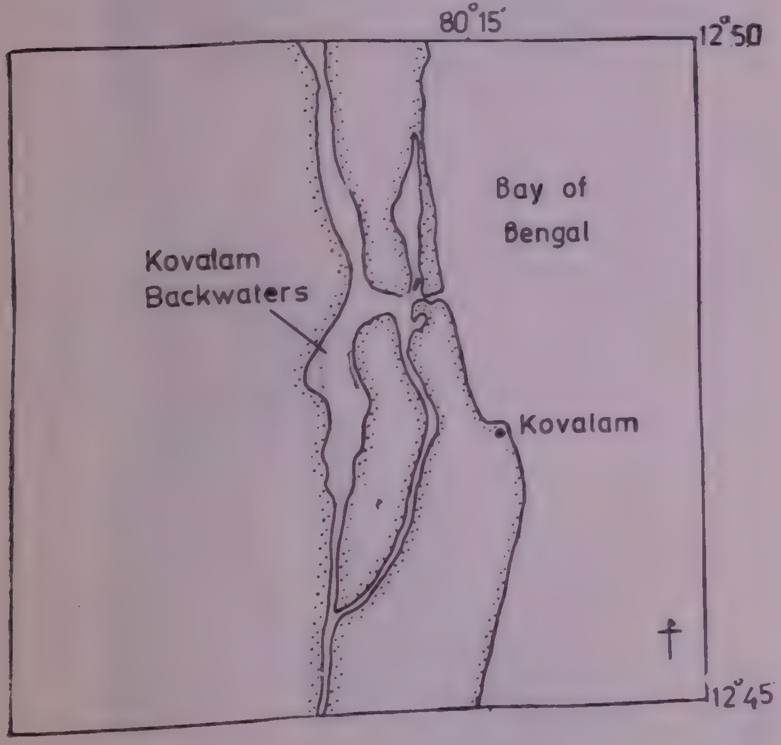

Fig. 1. The geographical position of Kovalam Bay and backwaters.

It is reported that eighteen years ago, in 1968, similiar erosion occurred here during which several palm trees and thatched huts as well as over ten 'pukka' houses further north were destroyed. The incursion of the sea at that time pushed back the village limit by about 50 m, as it has now been pushed back by another 60 m.

The Kovalam Bay

The general features of the Kovalam Bay are indicated in the map (Fig. 1). The shape of the bay is determined both by the crop of rocks located at the southern tip of the head-land and the Kovalam backwaters which drain into the bay 4 km north of these rocks. The coastline bordering the bay is a constantly

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*Prepared by Geeta Bharathan and E. V. Radhakrishnan, Madras Research Centre of CMFRI, Madras.

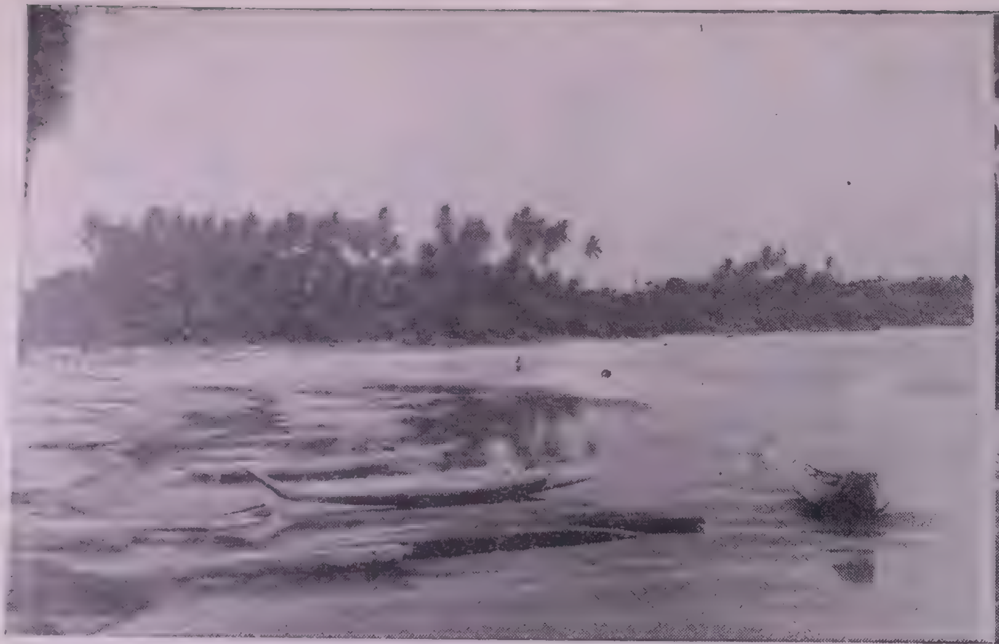


Fig. 2. The Kovalam beach in July, 1985. Note the flat profile of the beach compared to the sand mound in Fig. 10.

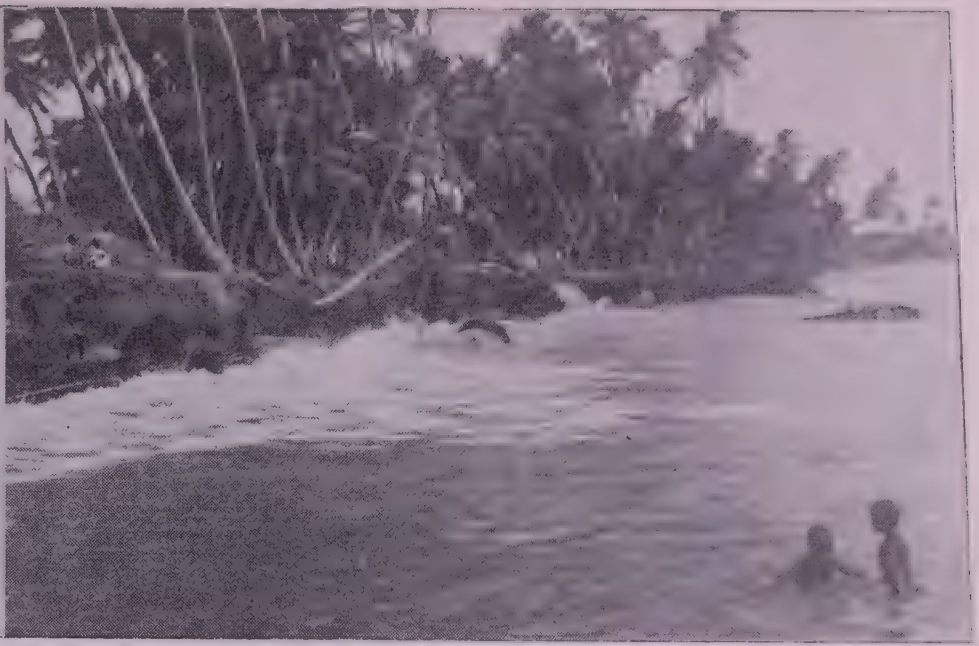


Fig. 3. View of erosion of palm grove as on 30th May, 1986.

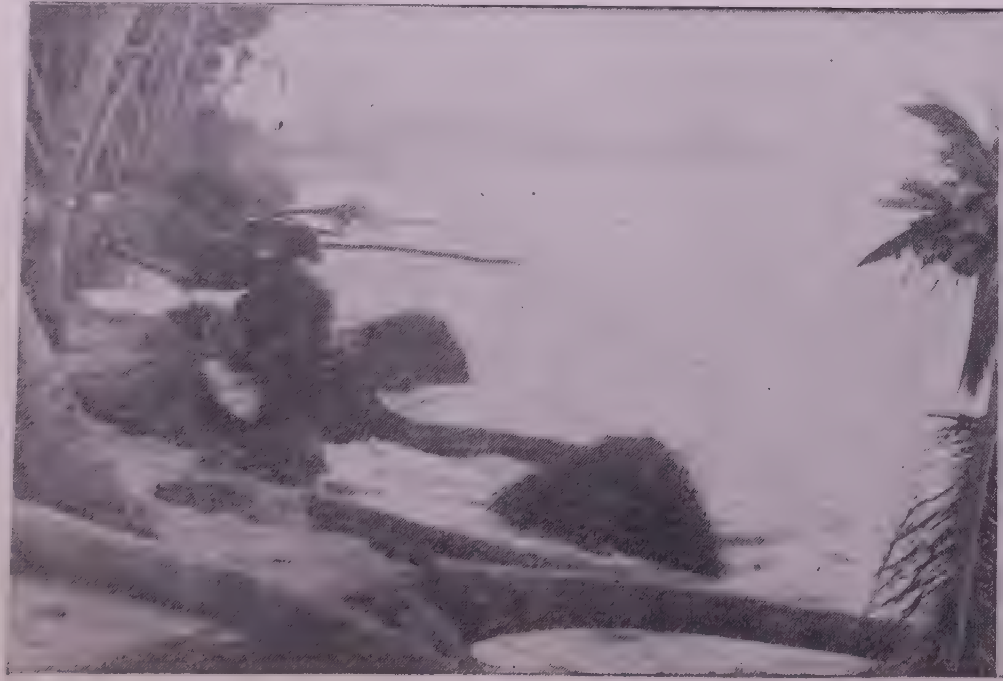


Fig. 4. Close-up view of erosion, 30th May, 1986.

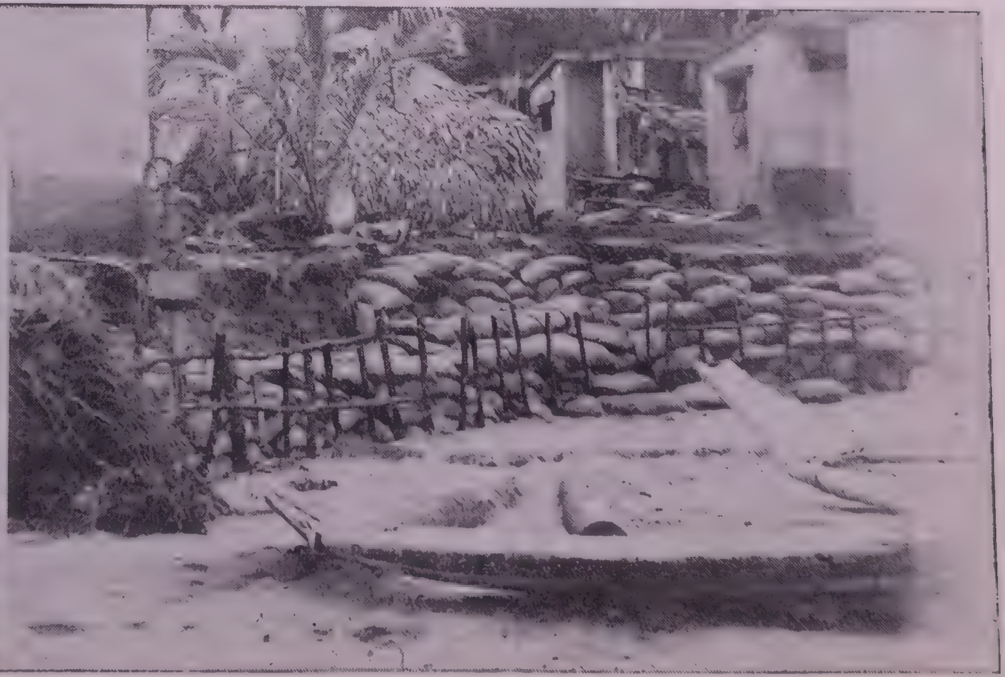


Fig. 5. Sand bags stacked on eroded beach infront of the houses for temporary protection.

shifting one which alters the contour and position in accordance with changes in the direction of current along the east coast.

No detailed studies have been conducted on current patterns in the Kovalam Bay, although hydrological features have been described by Muthusamy (*Indian J. Fish.*, **24**, 1980). The current pattern in the Bay of Bengal has been studied extensively and was reported to be southward during October and December, and northward during February and March (Ganapathy and Murthy, *Andhra Univ. Ser., No.* **49**, 1954). A similar pattern was reported by Srivastava and George (*J. mar. biol. Ass. India,* **18**, 1976).

Observations of local fishermen conform broadly to the above pattern. Daily records maintained at the Field Laboratory, Kovalam during 1979–'80, revealed that the current was southward during the period October–January. A short period of transition towards the end of January was followed by a reversal, the current then flowing in a northward direction from February until October.

Shifts in the coastline parallel these changes in current pattern. This annual cyclical shift in the coastline is represented in Fig. 6. Thus the sea retreats after April, and until October is at an approximate distance of 180-200 m from the road. During this period the prevailing current is northward. After October the sea starts moving southward into the land, eroding a large portion of the beach and by January–February it is at a distance of 100–120 m from the road. During this period the current is mostly southward.

There was a slight change in the above pattern during 1985–'86 when compared with the seven year period 1977–'84. The sea came very close to the road (upto 20 m) during early February, 1985 and receded after March. It started moving again in November, 1985 and was only 10 m from the road in March, 1986 (Fig. 7). Such close proximity of the sea had been observed by the authors only during the cyclone of May, 1979. The other time the sea came so close in the recent past was in 1968 when erosion occurred. At that time the road itself is said to have been submerged.

Sea erosion

In 1986 the sea did not retreat in April as it normally does, but remained close-by until May, exposing a new crop of rocks on the shore and eroding away different parts of the beach (Fig. 8). Shore seines landed large quantities of anchovies (about 2 tonnes) during this period. The sea became very rough during the lunar eclipse on April 24, 1986 and erosion increased. A huge anchor, 2 m high and weighing nearly 2 tonnes was uncovered by the sea (Fig. 9). Subsequently, by the second week of May, the sea started receding and a small sand mound was built up parallel to the coast on the beach infront of the Field Laboratory (Fig. 10).

The sea again became rough on May 23, full moon night and then started the process of erosion of the village. Apparently, erosion was severe because of the newly formed sand mound which deflected the surging sea away from the direction of the road into the village (Fig. 11). A large palm grove at the southern end of the village was destroyed and by May 29, much of the sand in that area was eroded away and two ancient sculptures were uncovered (Fig. 12). Similar monoliths had been removed in 1968 too (Fig. 13). The sea then moved further north, and entered the village to a distance of nearly 60 m from the normal water line, destroying 10 huts and 3 'pukka' houses (Fig. 14). It became calm by June 28 when no more damage was caused and by July it had receded well back (Fig. 15).

Kovalam backwaters

The Kovalam backwater is connected to the sea for only part of the year, usually during the period October–May. The mouth closes because of long-shore drift and is cut open by the Buckingham Canal Authority (PWD) when the water level in the canal exceeds 6.3 m. Examination of the annual rainfall at Kovalam and the total period of closure of the bar-mouth reveals a negative correlation ($r = -0.85$) between the number of months of closure and the total rainfall during the previous year (Table 1).

Unusually heavy rains in Chinglepet District during October, 1985 resulted in heavy flooding of the backwater, consequent to which the bar-mouth was forced open very wide and deep. By April, 1986 water flow at the mouth became much reduced. Rough sea conditions during the eclipse in the end of that month cut the bar wide open again and it remained so until November, 1986. This is quite unusual since the mouth normally closes by June (Table 1).

Table 1. *Total annual rainfall (1979–'85) and dates of closure and opening of barmouth of Kovalam backwaters with total period of closure*

Year	Total rainfall f(mm)	Sand bar		Period closed (months)
		Date of closure	Date of opening	
1979	1204	17–9–'79	4–11–'79	2
1980	1175	8–5–'80	13–11–'80	6
1981	1036	19–4–'81	2–11–'81	7
1982	796	3–2–'82	4–11–'82	9
1983	1356	11–2–'83	1–9–'83	7
1984	1397	15–6–'84	6–10–'84	4
1985	1858	10–6–'85	24–9–'85	3
1986	1005	—	—	2

During May-June 1986, the period of erosion, low tides did not uncover intertidal land masses in the backwater, eventhough the bar mouth was wide open. This situation continued until June 28, afterwhich intertidal patches were once again uncovered during low tide.

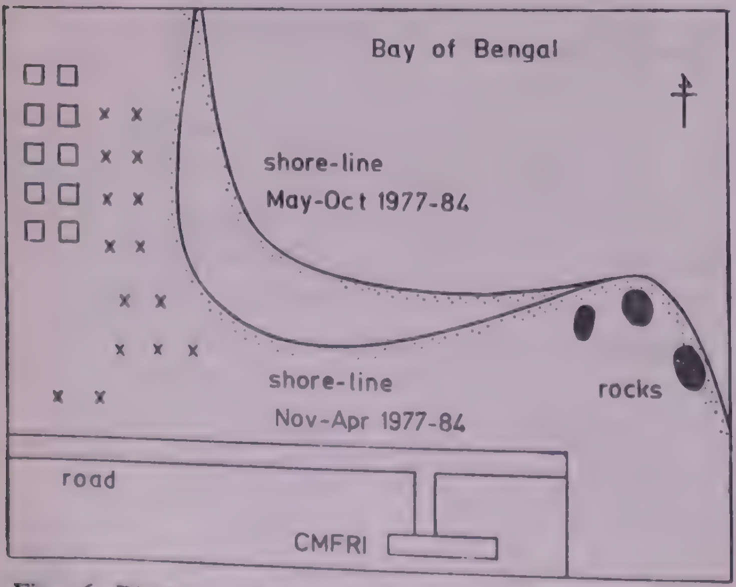


Fig. 6. Diagrammatic representation of southern end of bay showing seasonal shifts of coastline during 1977–'85. Lower line represents maximum limit of incursion and upper line shows extent of retreat by the sea (Not to scale).

These observations indicate heightened sea level during the period from April 24 to June 28.

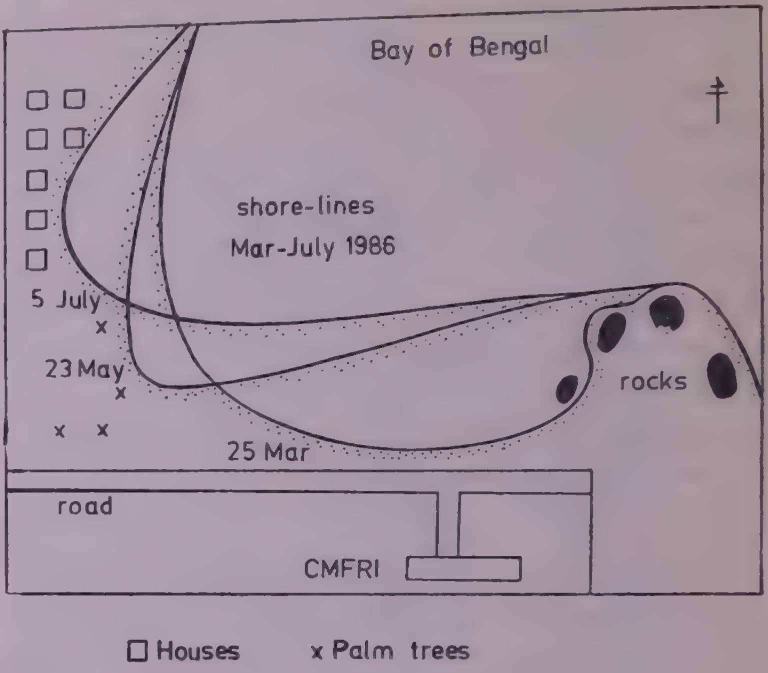


Fig. 7. Diagrammatic representation of southern end of bay showing shifting of coastline and erosion during 1986. The different lines indicate position of the sea on the dates depicted in the diagram. (Not to scale).

Drift organisms

Many bottom-dwelling and sessile animals such as gorgonians, sponges, ophiuroids, asteroids and crabs were washed ashore during May, 1986, and this is very unusual. The only other time in the recent past when significant quantity of sea life drifted ashore was in 1985. During that year a large amount of *Sargassum* and gorgonians was observed in July. This phenomenon lasted for over one week and was accompanied by a very strong northward current. *Sargassum* is not reported from the flora of rocks at Kovalam or Mahabalipuram and it is likely that these algae came from somewhere further south.

Fishery

The fishery off Madras during the period March–July, 1986 appears to have been somewhat different from the normal pattern. Apart from the heavy anchovy catches in March, 1986 mentioned earlier, unusually heavy landings of lesser sardines were observed at Kovalam during the first half of July. Similarly, off Madras too, heavy catches of mackerel and *Doryteuthis* sp. took place during April–June which was, indicative of changes in the sea conditions, since both species form major fishery on the west coast but are rarer on the east coast.

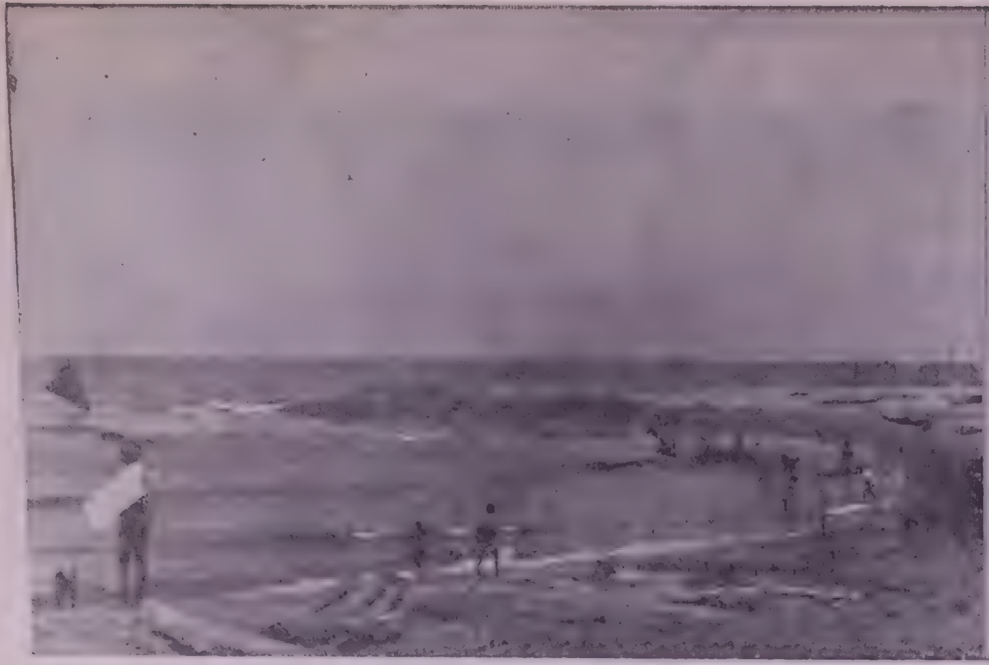


Fig. 8. Incursion of sea. Arrow indicates new crop of rocks exposed.

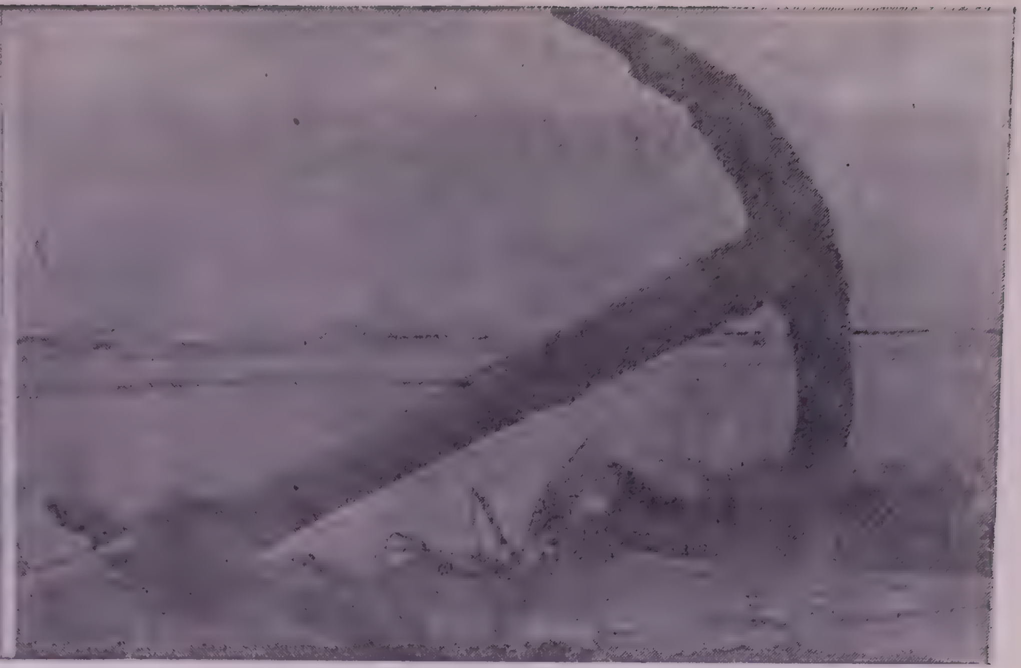


Fig. 9. Anchor recovered from sea bed in the eroded area, May, 1986.

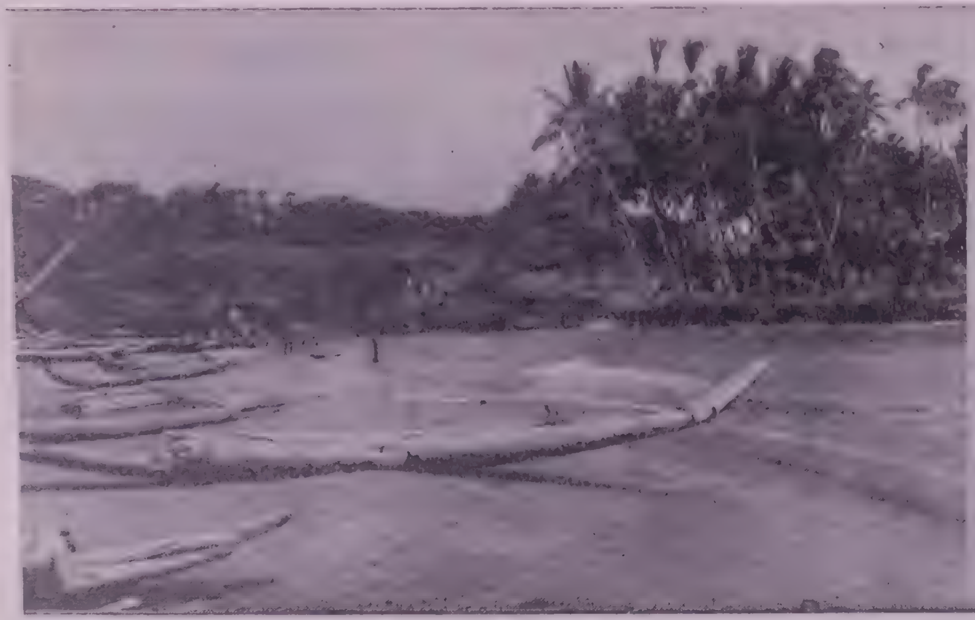


Fig. 10. View of beach showing sand mound formed after retreat of sea, 30th May, 1986.

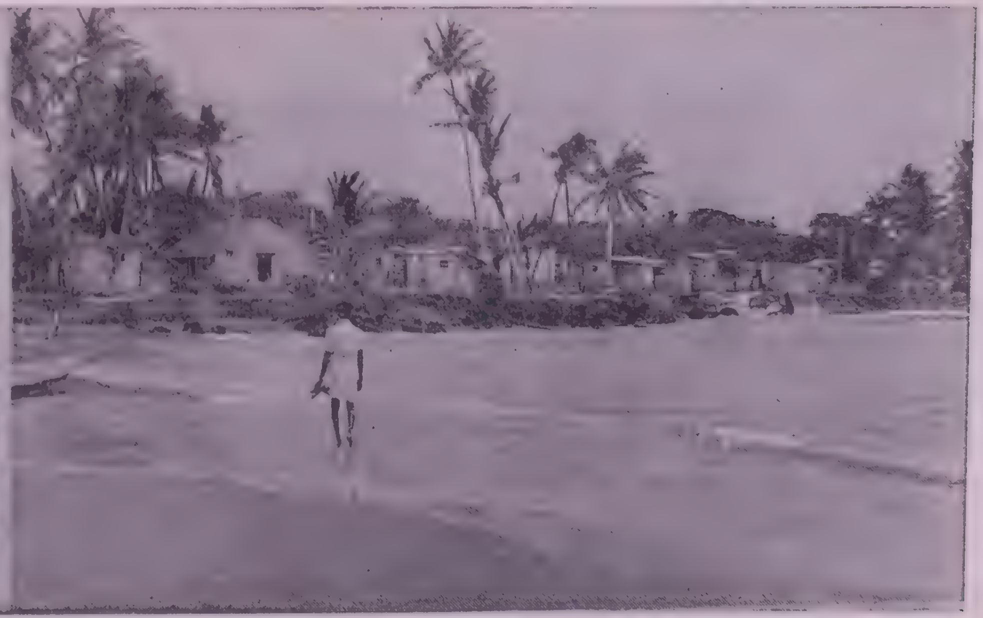


Fig. 11. Damages caused to the houses, 24th June, 1986

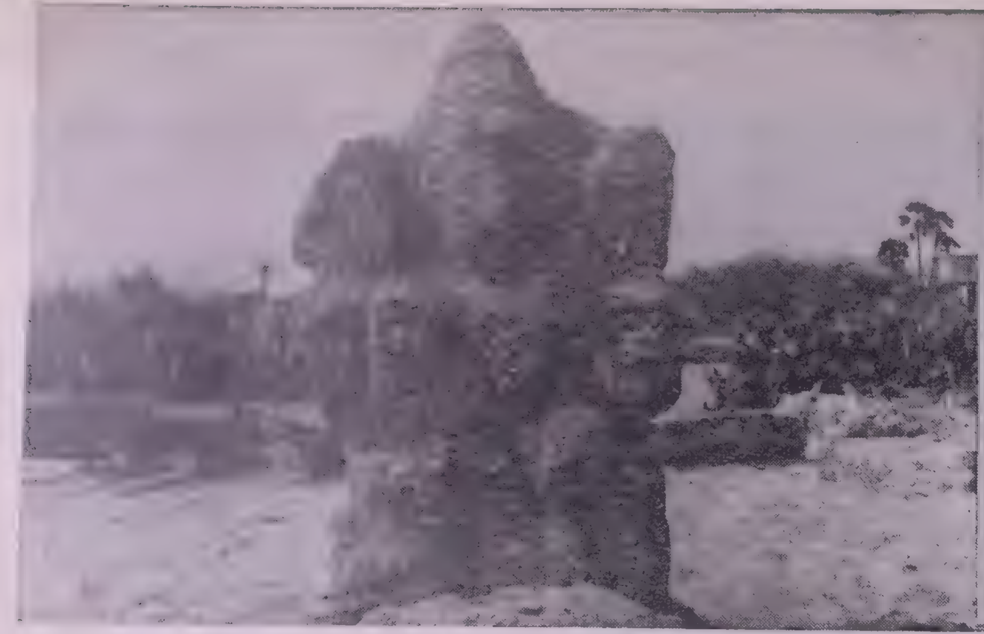


Fig. 12. Sculptures (Monoliths) recovered from sea bed in eroded area, 30th May, 1986.

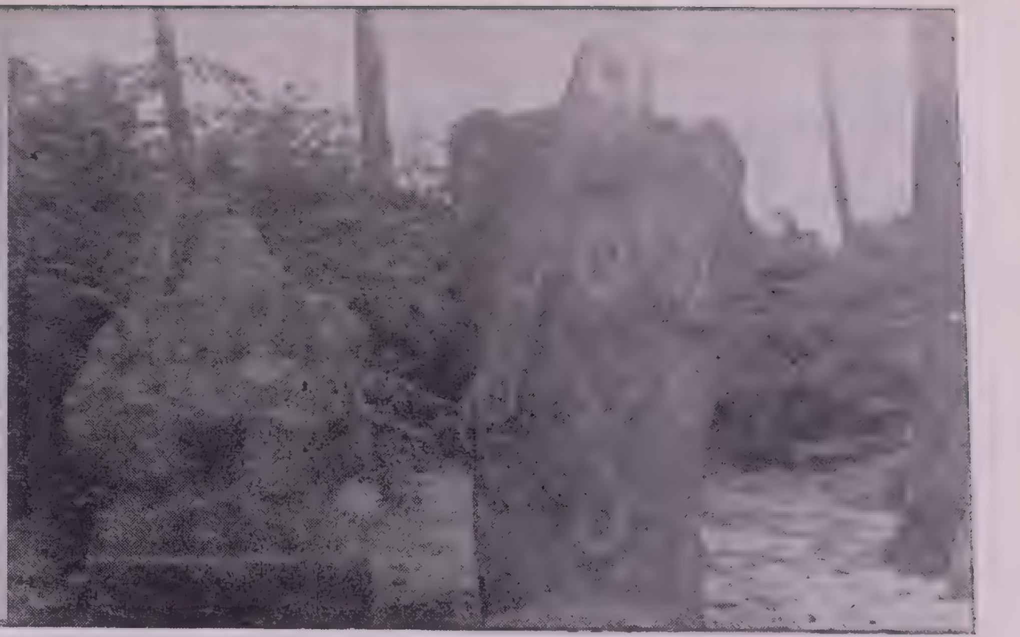


Fig. 13. Sculptures recovered from sea bed during previous episode of erosion in 1968.

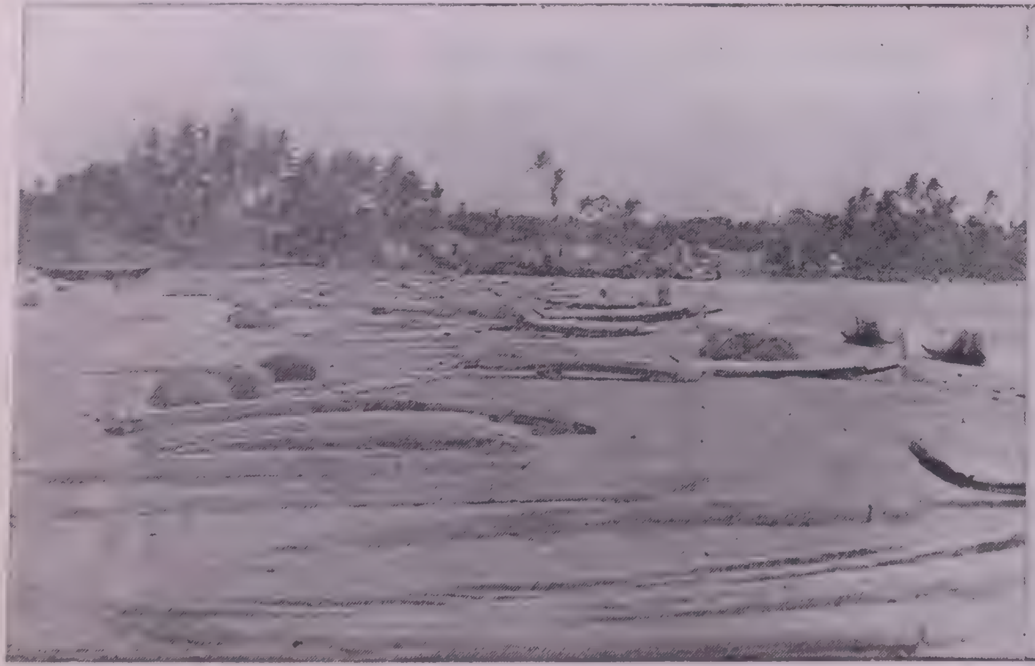


Fig. 14. A view of the village after destruction of houses and coconut palms taken place on 24th June, 1986. Compare the sparse stand of trees with the dense grove in Fig. 2.

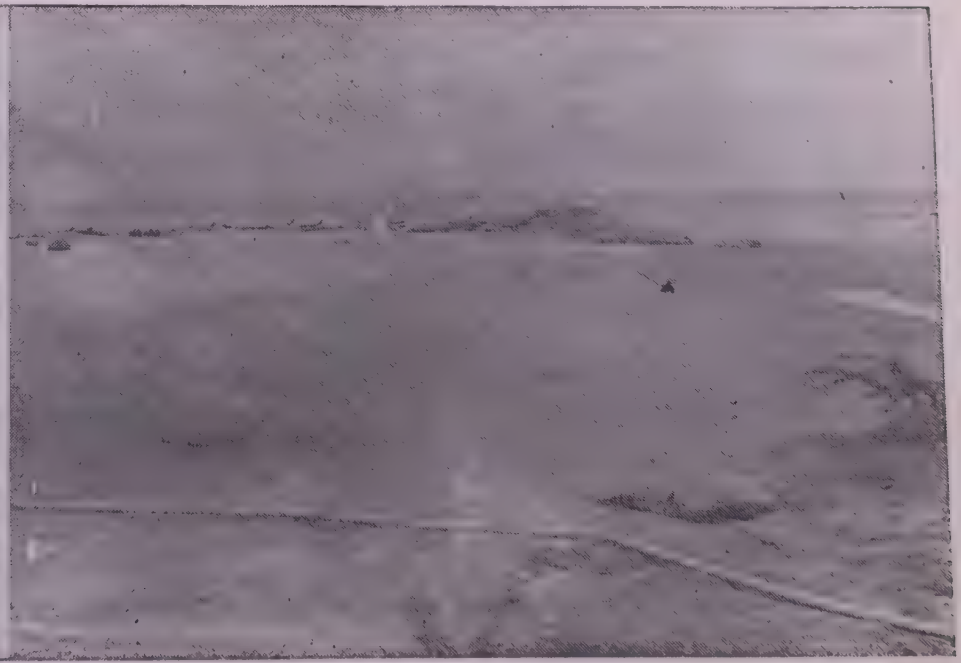


Fig. 15. Retreat of sea and deposition of sand, covering rocks earlier exposed. Compare with Fig. 6. Arrow indicates portion of these rocks.

Table 2. *Monthly averages of tidal height (in metres) off Madras for the years* 1983–'87

Year	J	F	M	A	M	J	J	A	S	O	N	D
1983	1.31	1.16	1.12	1·18	1.23	1.25	1.22	1.22	1.26	1.32	1.44	1.40
1984	1.27	1.19	1.16	1.20	1.26	1.20	1.19	1.24	1.31	1.36	1.29	1.34
1985	1.26	1.19	1.15	1.19	1.29	1.27	1.17	1.18	1.26	1.43	1.51	1.44
1986	1.27	1.14	1.12	1.25	1.29	1.24	1.19	1.18	1.21	1.32	1.47	1.47
1987	1.35	1.17	1.10	1.15	1.23	1.23	1.22	1.22	1.26	1.36	1.42	1.35

Discussion

Sea erosion on the east coast of India is fairly common during the northeast monsoon and has been recorded as far back as 1859 (Ahmed, *Coastal Geomorphology of India,* Orient Longman, 1972). However, its occurrence during the period May-August, as occurred in a wide-spread manner during 1986 is unusual. Erosion was observed, for instance, at Elliott's Beach in Madras city and was reported from Cuddalore also.

Erosion that occurred at Foreshore Estate, Madras, during August, 1977 was said to be the consequence of the flooding of Adayar River during November, 1976, followed by the formation of a sand bar in the sea. This bar deflected the direction of waves, causing them to strike the shore head-on, thus leading to erosion (Meenakshisundaram, Superintending Engineer, Madras Port Trust, personal communication). General observations indicate that a combination of unusual events may have been responsible for the erosion at Kovalam. The cumulative effect of the flooding of the backwaters during October, 1985 and probable deposition of silt, the formation of a sand mound on the beach as described earlier, and the rough, heightened sea conditions during May–June, 1986 might have led to the events described here.

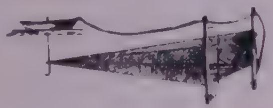
The following observations indicate an elevation of the sea level during April–June, 1986.

1. The submergence of normally exposed inter-tidal flats observed during April–June, 1986.
2. High water level during the period April–June, 1986 observed in the ponds at the Mariculture Centre, Muttukkad, when compared to the previous year (Annual Reports of Project MBO/MP/1.2, 1985–'86, '86–'87).
3. A steep rise in neap tide height during April, when it rose from 1.12 to 1.25 metre (Table 2). This rise was more steep and earlier in 1986, than during other years. The normal pattern of a rise during May–June, has been pointed out by Prasad and Reddy (*Indian J. Mar. Sci.*, **14**: 206-209, 1986).

Data of the Meteorological Department do not reveal any significant difference in the pattern of wind speed over the years, 1983–'86 (Jayanthi, Met. Dep. Madras, personal communication).

Conclusions

It is evident from our report that we need to have a fuller understanding of the hydrological parameters and current pattern of the Kovalam Bay than we have at present. The fishery and also the conditions in the farm of Mariculture Centre, Muttukkad are greatly influenced by events in the Bay. It is clear that a deep knowledge of conditions in the Bay would be of great value in studying the capture as well as culture fisheries of this area. Moreover, events like erosion could be predicted and preventive measures taken by the authorities concerned. The unearthening of old sculptures from the sea bed is of archaeological interest. Thus, extensive as well as intensive studies in this area would be of great value in the future.



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OCTOBER 1987

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Abbreviation – *Mar. Fish. Infor. Serv., T & E Ser.,* No. 76: 1987

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Front cover photo:

Green mussels growing on the dredger pantoons in Ennore Estuary, Madras. Ref: Article No. 3

Back cover photo:

A view of the polyethylene film-lined culture ponds on the sandy beach at Calicut. Ref: Article No. 4

MONSOON PRAWN FISHERY BY INDIGENOUS GEARS ALONG THE MANGALORE COAST

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Introduction

The large scale introduction of purse seines, in the late seventies for catching the pelagic resources, has adversely affected the traditional fisheries by *rampani,* cast net, *kanthabale, pattabale etc.* resulting in their elimination from this coast due to their low catches and poor return. This has compelled practically all fishermen, who had been actively engaged in traditional fishery, to opt for purse seining. However, when all mechanised fishing operations remain suspended during the southwest monsoon period (June–August) along this coast, the indigenous gears are operated for catching prawns, mackerel *etc.* since they fetch attractive prices. The most interesting fact was that these gears generally caught large sized prawns, occasionally in large quantities, from nearshore waters. An appraisal of the prawn fishery by indigenous gears in the monsoon season during 1979–'85 is attempted in the present account.

Fishing methods and season

Other than some subsistance fishery in the estuary, all fishing activities, along the Mangalore coast, remain suspended during the southwest monsoon period due to unfavourable weather conditions. Fishing operations are resumed on a small-scale in July or early August with the cast net operations. This is followed by the operations of gill nets like *kanthabale* and *pattabale.* Although these nets are primarily employed for catching prawns and mackerel, fishes belonging to other groups are also caught in appreciable quantities during this period. In addition, *kairampani* nets (small shore seine) are found to operate at certain centres to catch prawns and miscellaneous fishes. The introduction of *matabala* (small purse seine) in 1984 on a small scale and the subsequent addition in the following years have boosted the prawn landings during monsoon season.

The details of these indigenous gears except *matabala* are given by Prabhu *et al.* (1973) while studying the resources of Ullal in relation to certain environmental factors. *Matabala* is a miniature version of purse seine net, measuring about 240 m in length and 10 - 12 m in width, with a mesh size of 11-18 mm, and operated from two canoes (6-6.5 m in length) fitted with outboard engines. The number of crew members vary from 16 – 30. Like purse seines, these units also engage a canoe for transporting a part of their catch.

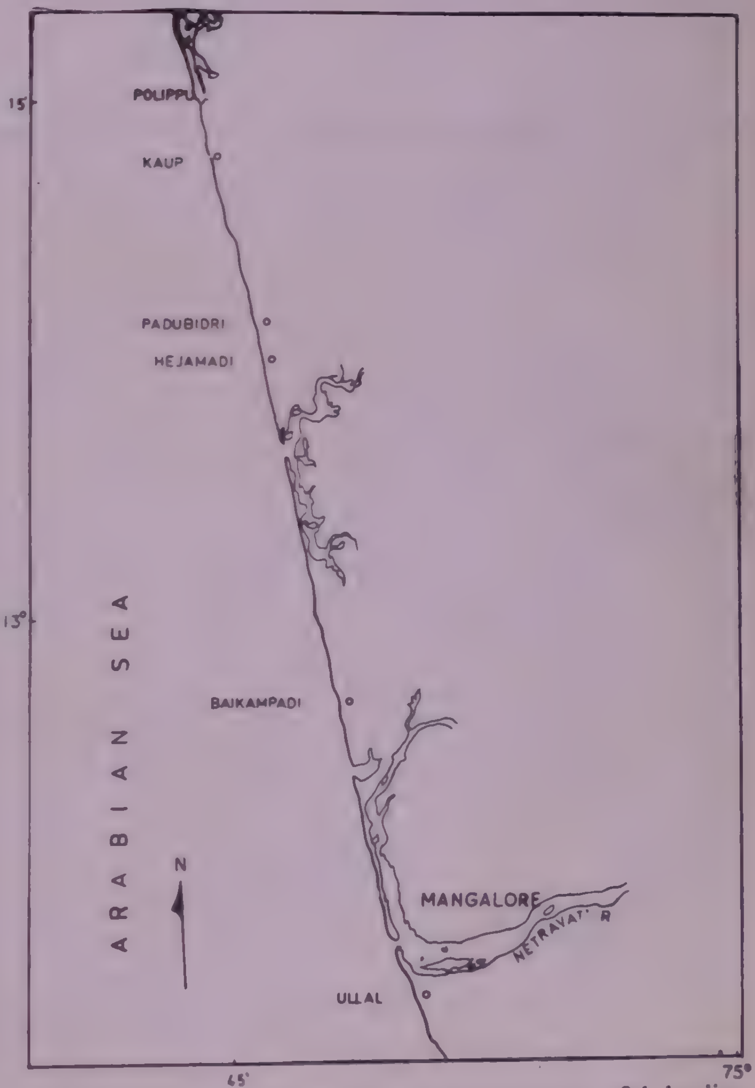

Fig. 1. The Mangalore coast showing the important fish landing centres for indigenous crafts.

These nets are operated all along the Mangalore coast at varying magnitudes during July–September when monsoon is not very active and sea conditions permitted fishermen to venture into the sea. Fishing is generally confined to nearshore waters within 15 m depth.

Although mud bank formations are a regular feature along the Alleppey-Quilon coast of Kerala, such a phenomenon has not been reported from this area. Hence, monsoon fishery is largely dependent on the weather conditions as well as the availability of shoals. Due to this, there has not been any consistency in the monsoon fishery. During the course of the present study, observations were made at Ullal, Bengre, Baikampady, Kulai, Polippu and Hejamadi where fishery was reported. Regular catch statistics were collected from Ullal and Baikampady only (Fig. 1).

Catch trends at Ullal and Baikampady

Prawn landings by indigenous gears generally occurred during July–September. The catch details for Ullal and Baikampady for 1979–'82 are given in Table 1.

Ullal: Fairly good landings of prawns were recorded in 1979 and 1980. There was no catch in 1981, 1983 and 1984. The maximum prawn landings were obtained in 1985. During 1979, the best catches were obtained in August (4,800 kg), whereas, in 1980, the catches were fairly high in July (9,105 kg). In 1982, the maximum prawn catch was recorded in September (3,748 kg), while in 1985, it was in July (61,569 kg).

Although cast net and *kanthabale* were operated at this centre, the former was found to be more productive contributing 90 to 95% of the prawn landings. *Matabala,* since its introduction in 1984 season, has dominated in the monsoon fishery contributing upto 100% of the prawn landings in 1985 at this centre.

Baikampady: The highest catches were recorded in 1981 when 8,780 kg of prawns were netted in a day. In 1979, prawns were caught only in September and the catch was negligible (40 kg). In the following year, prawn landings were fairly good in July and the catch amounted to 940 kg. In 1981, prawns were obtained only in September, while in 1982, landings occurred in August. During 1983 and 1984 seasons, there was

Table 1. *Estimated prawn landings at Ullal and Baikampady by indigenous gears during* 1979–'85

		ULLAL				BAIKAMPADY					
		Kanthabale	Cast net	*Matabala*	Total	*Kanthabale*	*Kairampani*	Cast net	*Pattabale*	*Matabala*	Total
1979	Catch (kg)	43	4,800	—	4,843	—	—	47	—	—	47
	Effort*	200	216	—		—	13	305	59	—	
	C/E**	0.21	22.22	—		—	—	0.15	—	—	
1980	Catch (kg)	948	10,426	—	11,374	—	72	1,119	—	—	1,119
	Effort	353	507	—		67	106	387	15	—	
	C/E	2.68	20.56	—	—	—	—	2.89	—	—	
1981	Catch (kg)	—	—	—	—	—	—	8,750	—	—	8,750
	Effort	—	—	—		—	—	420	—	—	
	C/E	—	—	—		—	—	20.8	—	—	
1982	Catch (kg)	—	1,974	—	—	951	—	9	2,053	—	3,013
	Effort	—	480	—		36	—	49	64	—	
	C/E	—	4.11	—		26.42	—	0.20	32.08	—	
1983 & 1984			No catch		—			No catch			—
1985	Catch (kg)	—	—	61,569	61,569	—	—	—	—	1,540	1,540
	Effort	—	—	119		—	—	—	—	158	
	C/E	—	—	517.39		—	—	—	—	9.75	

* Effort in numbers of units

** C/E - catch per boat per day

no landings by these gears. In the following year, catches were obtained only in July.

Although cast nets, *pattabale* and *kanthabale* were operated, cast nets were found to be more productive contributing up to 95–100% of the annual prawn landings by the traditional gears.

Species composition

Ullal: Metapenaeus dobsoni was the dominant species contributing 100, 99, 100 and 100% during 1979, 1980, 1982 and 1985 respectively. *Penaeus indicus* was caught only during 1980 and formed only 1% of the annual prawn landings by traditional gears.

Baikampady: M. dobsoni was the principal species contributing 80, 100, 100 and 94% of the prawn catch during 1979, 1980, 1981 and 1985 respectively. This species was not available during 1982 at this centre. *P. indicus* catch was negligible during 1979. In 1980 and 1981 also, this species was completely absent. However, in 1982, *P. indicus* catch was fairly high (3,013 kg).

In addition, penaeid prawns like *Parapenaeopsis stylifera* and *Penaeus monodon* were also caught in stray numbers.

Size distribution

In *M. dobsoni*, the size ranging from 63 to 108 mm (modes at 88 and 98 mm) in males, and from 73 to 123 mm in females (modes at 83 and 108 mm) supported the fishery (Fig. 2).

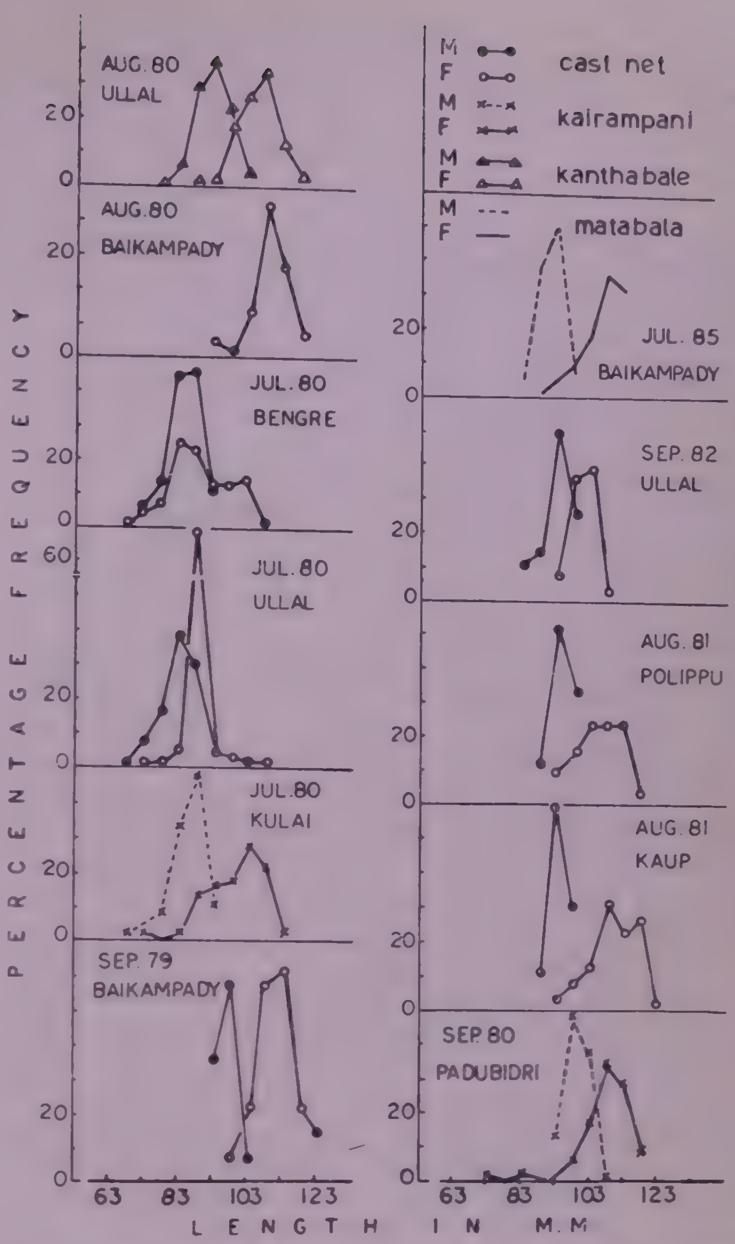

Fig. 2. Size frequency distribution in *M. dobsoni* caught in different indigenous gears at various centres.

Table 2. *Sex ratio distribution in* M. dobsoni *and* P. indicus *at Ullal and Baikampady*

	M. dobsoni				*P. indicus*			
	Baikampady		Ullal		Baikampady		Ullal	
	Male	Female	Male	Female	Male	Female	Male	Female
September, 1979	35.0	65.0 (CN)	—	—	—	—	—	—
July, 1980	52.5	47.5 (SS)	28.2	71.8 (CN)	—	—	—	—
August, 1980	—	100.0 (CN)	34.7	65.3 (KN)	—	—	—	—
September, 1980	59.3	40.7 (SS)	—	—	42.1	57.9 (KN)	—	--
August, 1981	20.4	80.0 (CN)	—	—	—	—	—	—
August, 1982	—	—	—	—	42.3	57.7 (PN)	—	—
September, 1982	—	—	50.0	50.0 (CN)	—	—	—	—
July, 1985	74.2	25.8 (MT)	38.2	61.8 (MT)				

CN – Cast net; SS – *Kairampani* net; KN – *Kanthabale;* PN - *Pattabale;* MT – *Matabala.*

In *P. indicus*, the size ranged from 133 to 163 mm (modes at 143 and 158 mm) in males, and from 138 to 178 mm (modes at 153 and 168 mm) in females (Fig. 3).

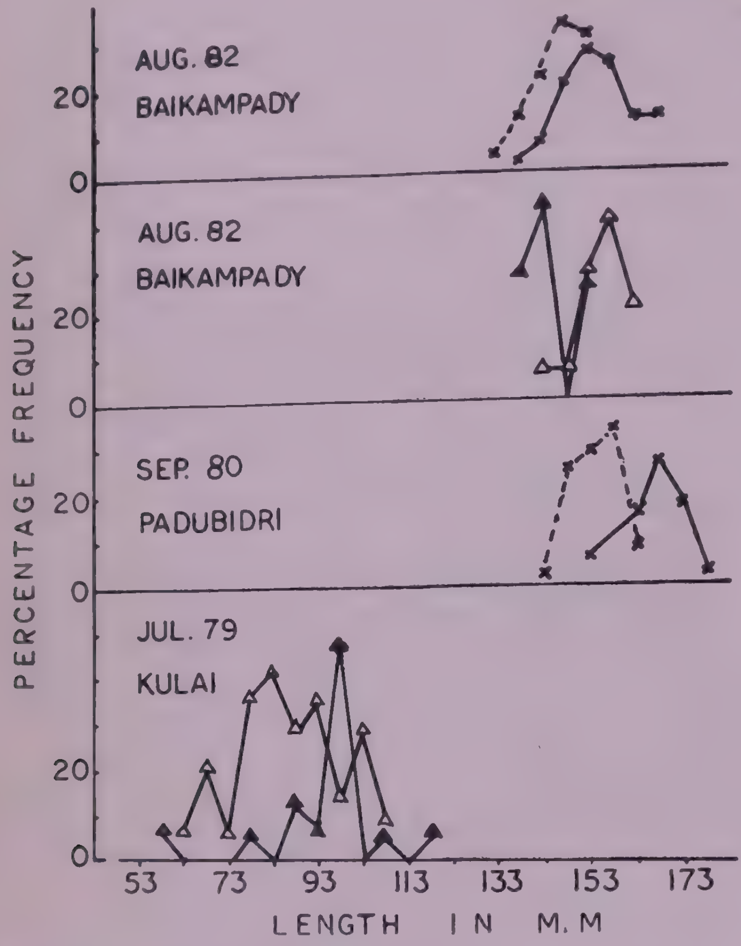

Fig. 3. Size frequency distribution in *P. indicus* caught in different indigenous gears at various centres.

However, in July 1979, smaller sizes ranging from 58 to 118 mm in males and from 63 to 108 mm in females were found to occur in the fishery at Kulai.

It is striking to note that the monsoon fishery was supported mainly by large sized prawns of *M. dobsoni* and *P. indicus*. There was no marked variation in the sizes of these prawns obtained in different gears at a particular centre during the same period. However, marginal variations were noticed in the size of *M. dobsoni* in the same gear at different centres during the same period.

Sex ratio and maturity

Overall sex ratio indicated that females out-numbered males in *M. dobsoni* and *P. indicus*. In *M. dobsoni*, preponderance of females was very high in cast nets, whereas, males were more in *kairampani* nets (Table 2). In *matabala*, females were more at Ullal, but males dominated in the catch at Baikampady.

It is also seen that most of the females of *M. dobsoni* were in the spent condition.

General Remarks

The monsoon fishery by traditional gears is particularly significant since it gives certain amount of livelihood to fishermen at a time when all mechanised fishing activities remain suspended all along this coast. It is also interesting to note that the fishery was mostly supported by large sized prawns of *M. dobsoni* and *P. indicus*. Since it is off season, and prawns, generally, are of large size, they fetch exhorbitant prices. The introduction of *matabala* in 1984 and the subsequent addition during the following seasons, have boosted the prawn landings to a large extent, along this coast.

During June–August, there is a gap in the biological data collected from the mechanised trawlers due to the suspension of mechanised fishing during this period. The indigenous fishery during the monsoon season is immensely helpful in providing some valuable data on the size composition, sex ratio, maturity *etc.* of *M. dobsoni* and *P. indicus* during this period, thereby enriching our knowledge on the resource characteristics of these prawns

The author is grateful to Shri M. S. Muthu, Scientist S-3 and Head, Crustacean Fisheries Division, Central Marine Fisheries Research Institute, Cochin for going through the manuscript and suggesting improvements.

* * *

ERRATUM

The species of cat fish *Arius thalasinus* given in article 6 of MFIS 73, page 14, July, 1987 may be read as *Tachysurus dussumieri*.

— Editors

HEAVY LANDINGS OF *STOLEPHORUS DEVISI* BY SHORE SEINES ALONG MADRAS COAST*

Unusual heavy landing of *Stolephorus devisi* was observed in shore-seines operated during March, 1986 along the landing centres from Kottivakkamkuppam to Oyyalikuppam south of Mahabalipuram, southern-side of Madras. Though the fishery of these landing centres used to be contributed by substantial quantities of *Stolephorus* sp. this year it was unusual.

Occurrence of *Stolephorus* sp. in the shore-seine catches at Kovalam landing centre was observed from 21st March, 1986 onwards. To start with, it was about 350 kg per shore-seine but gradually increased on the subsequent days to reach a maximum of 1,750 kg per unit per haul on 24th March, 1986 and thereafter the fishery declined slowly to 113.3 kg per unit on 27th March, 1986. The same trend of fishery was observed at Kottivakkamkuppam, Injambakkamkuppam, Panayurkuppam, Nainarkuppam, Pudukuppam, Nemelikuppam, Kokrimedukuppam and Oyyalikuppam landing centres also (Table 1). Anchovy fishery started at Kottivakkamkuppam on 18th March, 1986 itself, three days prior to the occurrence at Kovalam landing centre.

Table 1. *Quantity of* Stolephorus devisi *landed by shore-seine in different landing centres*

Landing centre	Date	No. of units operated	Estimated catch (kg)	CPUE (kg)
Kovalamkuppam	21-3-1986	3	1,050	350.00
	22-3-1986	5	2,810	562.00
	23-3-1986	6	6,210	1,035.00
	24-3-1986	6	10,500	1,750.00
	25-3-1986	5	5,200	1,040.00
	26-3-1986	4	2,430	675.00
	27-3-1986	4	780	195.00
Kottivakkamkuppam	18-3-1986	3	340	113.33
Injambakkamkuppam	25-3-1986	2	1,800	900.00
Panayurkuppam	22-3-1986	4	247	61.75
	23-3-1986	4	1,400	350.00
	24-3-1986	4	2,995	748.74
	25-3-1986	4	38	9.50
Nainarkuppam	21-3-1986	4	5,700	1,900.00
Pudukuppam	26-3-1986	2	6,000	3,000.00
Nemmelikuppam	24-3-1986	4	5,000	1,250.00
	25-3-1986	4	6,000	1,500.00
Kokrimedukuppam	21-3-1986	1	300	300.00
	22-3-1986	3	1,160	386.67
Oyyalikuppam	25-3-1986	1	55	55.00

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*Prepared by R. Thangavelu, M. Bose and P. Poovannan, Madras Research Centre of CMFRI, Madras.

The incidence of high catches with wider fluctuations was recorded for a period of 10 days between 18th and 27th March, 1986 from Kottivakkamkuppam to Oyyalikuppam landing centres. No anchovy fishery was observed after this period. Apart from the anchovies, silver bellies, mackerel and lesser sardines were also found in the catches in negligible numbers.

Though there was a demand for this fish on the first two days in the local market, it declined during later days. At Nainarkuppam 5,700 kg of anchovies were sold for Rs. 15,000/- on 21st March, 1986, while at Panayurkuppam 1,500 kg were sold for Rs. 4,000/- on 24th March, 1986. Since there was no demand at Kovalam market, all the anchovy catches were sun-dried on the sandy beach and later transported by lorries to Madras. The dried fish was sold at the rate of Rs. 8/- per kg at the local market of Kovalam.

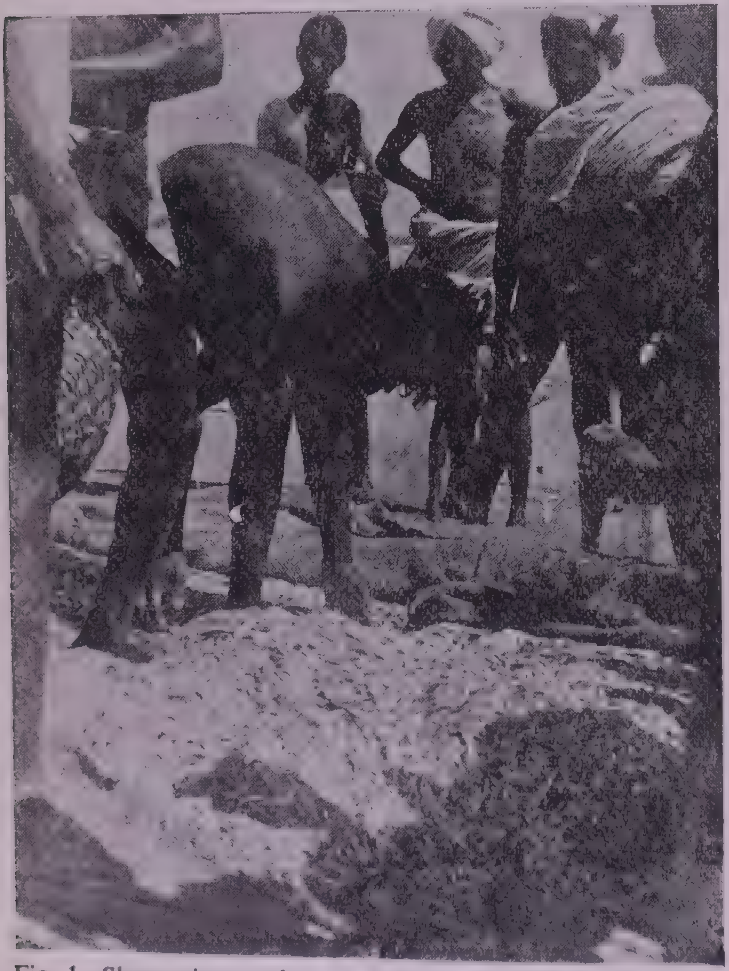

Fig. 1. Shore-seine catches of *Stolephorus* at Kovalam landing centre.

A random sample was collected from the shore-seine catches and analysed. The size ranged between 55 and 85 mm and the modal size group was 70–74 mm which contributed to 30.95% of the catches. Males constituted 54.76% while females and indeterminates formed 42.86 and 2.38% respectively in the population. Immature and maturing gonads were observed to be common in both the sexes.

Fig. 2. Fisher-folk gathered around the catches.

Gut content analysis showed that the food was in a semi-digested condition and also observed the presence of numerous sand grains in a majority of fishes. The food of *Stolephorus* was mainly constituted by copepods (*Paracalanus*, *Oithona* and *Euterpina* sp.). However, the other items like mysis, megalopa larva of crab, fish eggs, cypris larva of barnacle and tintinnids; with sporadic occurrence of phytoplankton such as *Coscinodiscus*, *Nitzschia*, *Rhizosolenia* and *Pleurosigma* were also observed. From the analysis of stomach contents and plankton of Kovalam Bay, it is evident that occurrence of such heavy catches during a shorter duration of 10 days along the landing centres of Madras coast was probably due to presence of its favourite food along the coastal areas.

Salinity and temperature were found to be 34‰ and 30°C respectively at Kovalam Bay. It was understood that the water current was gently moving towards north. No wave action was observed in the bay waters. The fact that the fishery started first at the northern point of Kottivakkamkuppam and then gradually shifted towards south indicates that the shoal was moving towards south against the water currents.

OCCURRENCE OF MUSSEL SEED ON DREDGER PANTOONS IN ENNORE ESTUARY, MADRAS*

Several species of fouling organisms settle and grow on ship hulls, pantoons, buoys, dredgers and other floating structures in the sea and in the backwaters and estuaries. At the mouth of Ennore Estuary, two dredgers are employed by the Ennore Thermal Power Station to regularly remove the sand. This is done to keep the bar-mouth open throughout the year so as to supply water to the cooling tower of the thermal power plant. The main dredger and its machine parts are supported by 2 rectangular side pantoons on either side, each of dimensions of 13 x 2 x 1.8 m (Fig. 1). There are also paired cylindrical pantoons located behind the dredger, each pair weighing 1.5 tonnes. The dredged sand alongwith a jet of water is forced through steel pipe line of 1/2 metre diameter, followed by vinyl pipe line. The latter rests on the pantoons arranged adjacent to one another at a distance of 1 to 2 metres. The pipe line system is of about 400 metres long. Each pantoon is a steel drum with a length of 3.5 metres and a diameter of 1.25 metres. The pantoon is partly immersed in the water and offers suitable surface for the settlement of fouling organisms.

The major fouling organisms observed on the pantoons were mussels, oysters and barnacles, of which the green mussel *Perna viridis* is the most dominant (Fig. 2). The pantoons are usually hauled up from the water during November every year for removing the fouling organisms and are re-floated in the water around February. Between February and November, heavy settlement of fouling organisms was noticed.

The extent of fouling on the pantoons can be understood from the abundance of the green mussels (Fig. 3). The total quantity of mussels on the pantoons was estimated by taking subsamples *i.e.*, the number and weight of mussels in 1/4 m^2, sampled randomly and raising them for the total area of settlement. In November of 1985 and 1986, the mussels removed from the pantoons amounted to 8.5 million (25 t) and 8.6 million numbers (27 t) respectively. The former came from 56 cylindrical pantoons and four rectangular pantoons and the latter from 48 pantoons. The size range of mussel recorded during 1985 was from 5 to 84 mm with modal groups of 15–19, 55–59 and 60–64 mm. In 1986, the size range was 5 to 69 mm, the modal groups being 10–14 and 55–59 mm. On both the occasions, young spat settled recently prior to removal of pantoons from water, constituted the bulk of the population to the extent of 64.4% in 1985 and 48% in 1986. Size range of this groups was from 5 to 29 mm which was ideally suitable for transplantation in mussel culture experiments. Details regarding the area of mussel spat settled, density, size range and modal size group are given in Table 1.

It is significant to note that millions of mussel spat are removed from the pantoons every year (Fig. 4) and thrown on the sandy beach. Shortage of mussel seed has been considered to be the major constraint in the intensification of mussel culture on industrial scale (Silas, E. G., *Bull. Cent. Mar. Fish. Res. Inst.*, **29**: 51-56, 1980). The large quantities of mussel spat which are available can very well be used for mussel culture in the backwaters or lagoons.

The above observations reveal the high magnitude of mussel seed settlement which occurs in areas like Ennore, and these can be effectively collected by providing suitable spat collectors.

Table 1. *Data on green mussel at the time of removal from the pantoons*

Details	1985	1986
1. Number of pantoons	56 cylindrical and 4 rectangular	48 cylindrical and 4 rectangular
2. Total area with mussel (m^2)	703	638
3. Estimated mussel (numbers)	8,558,322	8,615,638
(weight in tonnes)	24,733	26,961
4. Number of mussel/m^2	12,174	13,501
5. Weight of mussel/m^2 (kg)	35,183	42,258
6. Size range (mm)	5–84	5–69
7. Modal size groups (mm)	15–19 55–59 60–64	10–14 55–59
8. Mean size (mm)	32.0	33.0
9. Mean weight (g)	2.89	3.13

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*Prepared by P. V. Sreenivasan, R. Thangavelu, R. Sarvesan and P. Poovannan, Madras Research Centre of CMFRI, Madras - 600 105.

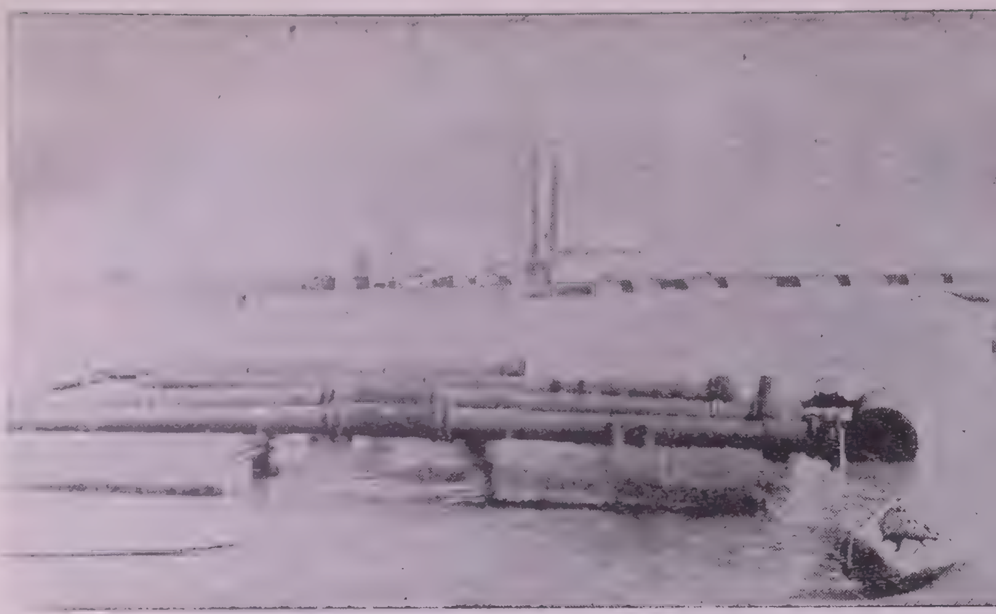

Fig. 1. The dredger and pantoons floated in Ennore Estuary.

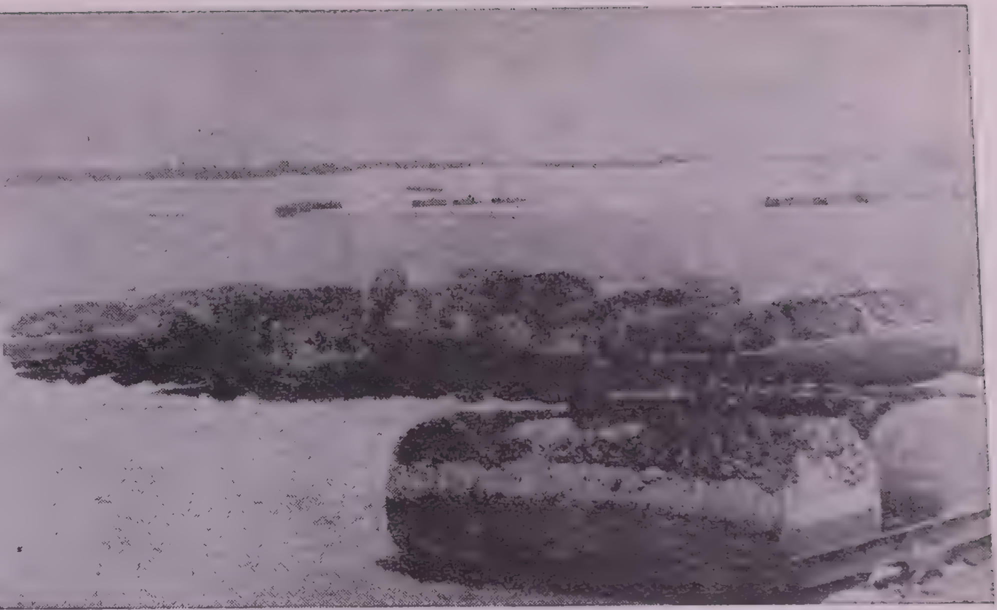

Fig. 2. Dense growth of green mussels, barnacles and oysters on pantoons.

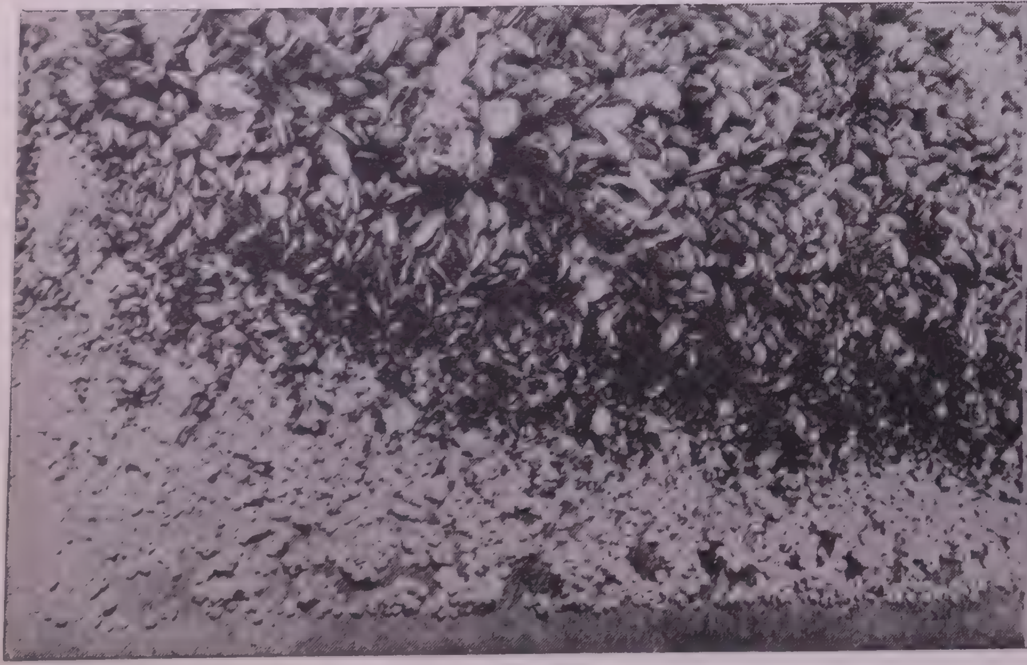

Fig. 3. A close-up view of the green mussels, oysters and barnacles on a pantoon.

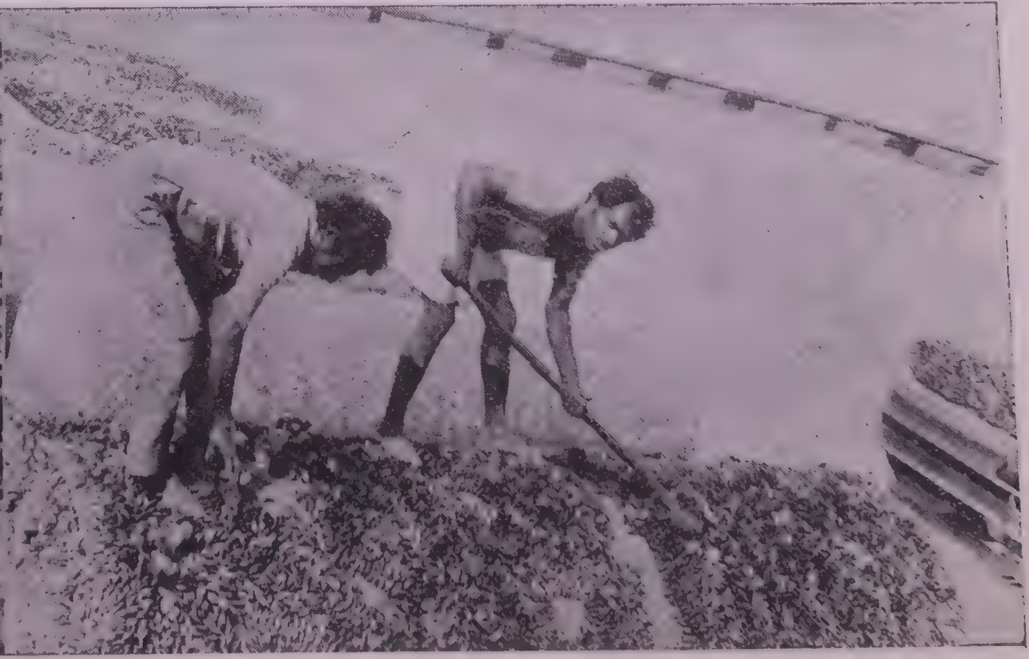

Fig. 4. The encrusted organisms are being removed from the pantoons.

CULTURE OF MILKFISH IN POLYETHYLENE FILM-LINED PONDS*

Introduction

The milkfish *Chanos chanos* is widely distributed in the subtropical and tropical regions of the world. It is euryhaline, hardy and fast-growing. Large scale culture of milkfish is undertaken both in brackish and seawater farms of Philippines, Indonesia and Taiwan.

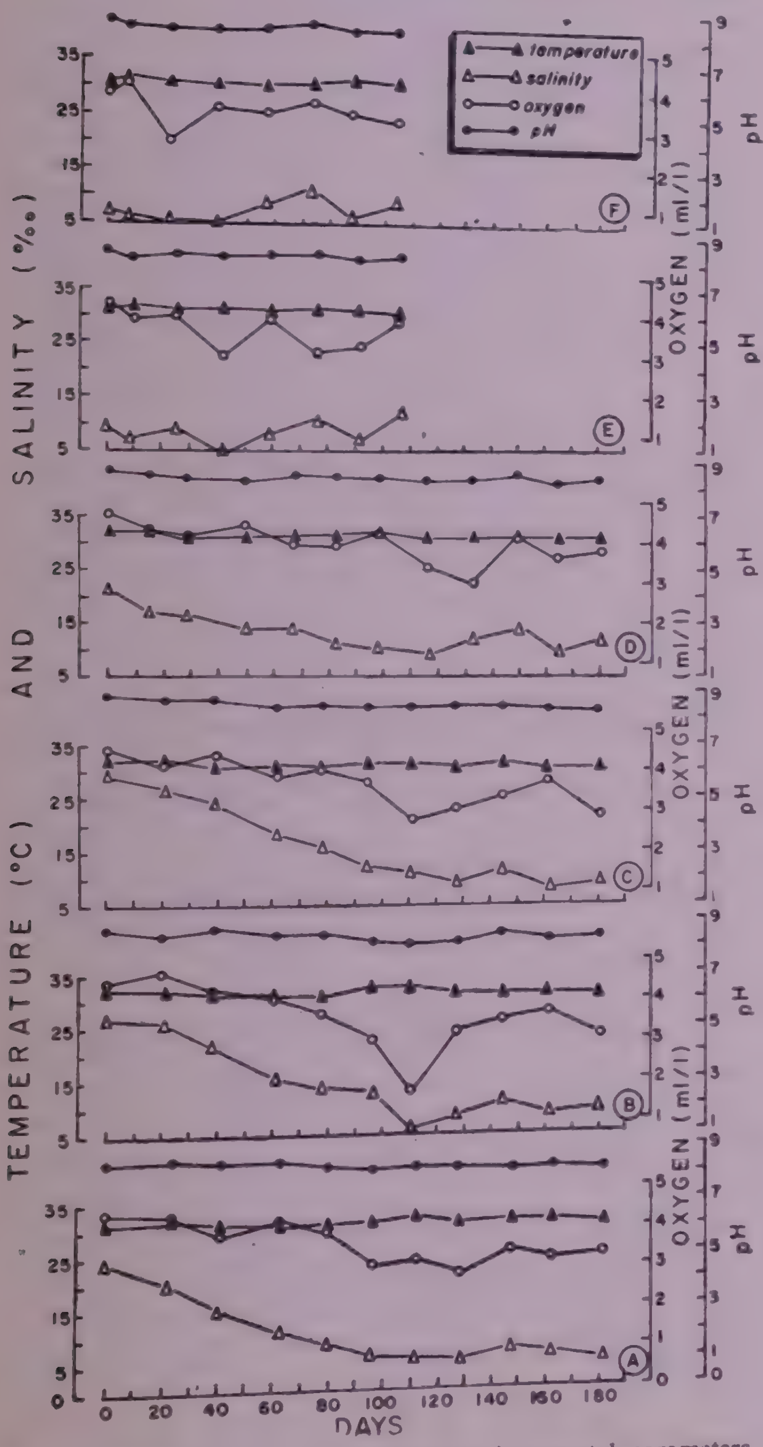

Fig. 1. Fluctuations in the values of environmental parameters recorded in the ponds.

In India interest in the commercial farming of milkfish has grown apace in recent years following many successful experiments conducted in earthern ponds and coastal pens. Considering the importance of converting the barren sandy beaches for aquaculture purposes an attempt was made at Calicut to culture the milkfish in ponds dug out in the sandy beach and lined with polyethylene film. Two sets of experiments were conducted in those ponds during the period June, 1983 to January, 1984. The culture experiments became highly successful and the harvest was shown to the fish farmers and general public by way of a harvest mela (Figs. 1–6).

Preparation of ponds

The ponds were prepared as described by Lal Mohan and Nandakumaran *(Mar. Fish. Infor. Serv., T & E Ser.,* **26**: 6-8, 1980), during April-May before the onset of southwest monsoon. This period, because of its dry nature, facilitates quick drying of the ponds after dewatering and this in turn makes it easier for cleaning and repairing or changing the lining. Sea water was pumped into the ponds with a 5 H. P. diesel pump by tying the foot valve to a float anchored in the sea at a distance of about 90 m from the shore. Fresh water, when needed was pumped from a well by a 5 H. P. electrical pump. About 1.5 m water depth was maintained in the ponds throughout the period of experiment.

Seed

Seed were collected from the tidal pools between Korapuzha and Kadalundi in the Malabar area, using an ordinary mosquito net. A total of 4,127 seed, ranging in size from 15 to 62 mm total length, were collected during July, '83 alone. Soon after the collection the seed were brought to the fish farm in plastic bins and acclimatised by keeping them in fibre glass tanks. After acclimatisation the healthy ones were counted and stocked in the ponds (A–D) as per the details given in Table 1. As the number of ponds was not sufficient to stock all the seed collected, some quantity was stored in a nursery pond for about three months during which two additional ponds were made ready. The stored seed, with stunted growth, were then released into these ponds (E and F).

Feed

The stocked fish were fed with compounded feed made out of groundnut oil cake (30%), powdered tapioca waste (30%), powdered prawn head (25%) and rice bran (15%). The feed ingredients were mixed up thoroughly, cooked well and allowed to cool before being served in a dough form in trays kept at the corners of the pond. Depending upon the size of the fish and feed requirement the quantity of feed to be supplied to the ponds was regulated. It varied from five times the body weight in the beginning of the experiment to 1/50 the body weight towards the end of the experiment in some of the ponds.

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*Prepared by S. Lazarus and K. Nandakumaran, Calicut Research Centre of CMFRI, Calicut.

Environmental conditions of the culture ponds

Organic waste and other detritus found on the bottom of the ponds were removed periodically by siphoning out the bottom water with the help of 80mm flexible hose. The water loss by this and also due to evaporation was compensated by pumping water into the ponds. Estimation of dissolved oxygen, salinity and pH was made twice in a week and temperature noted twice daily at 1000 and 1400 hrs. Temperature fluctuated within a narrow range of 31.0 – 32.5°C in the ponds throughout the experiment. Maximum salinity values of 24.2, 27.3 and 29.2‰ were obtained in ponds A, B and C respectively at the beginning of the experiment and a minimum of 5.0, 9.1 and 6.1‰ respectively towards the end of the experiment. In the other three ponds, however, this difference was not significant. Dissolved oxygen values ranged between 2.6 and 4.7 ml/l in all except pond B in which it touched a lower value of 1.8 ml/l around 110th day of stocking. The pH values ranged between 8.1 and 8.9. The fluctuations in these values in the ponds are shown in Fig. 1.

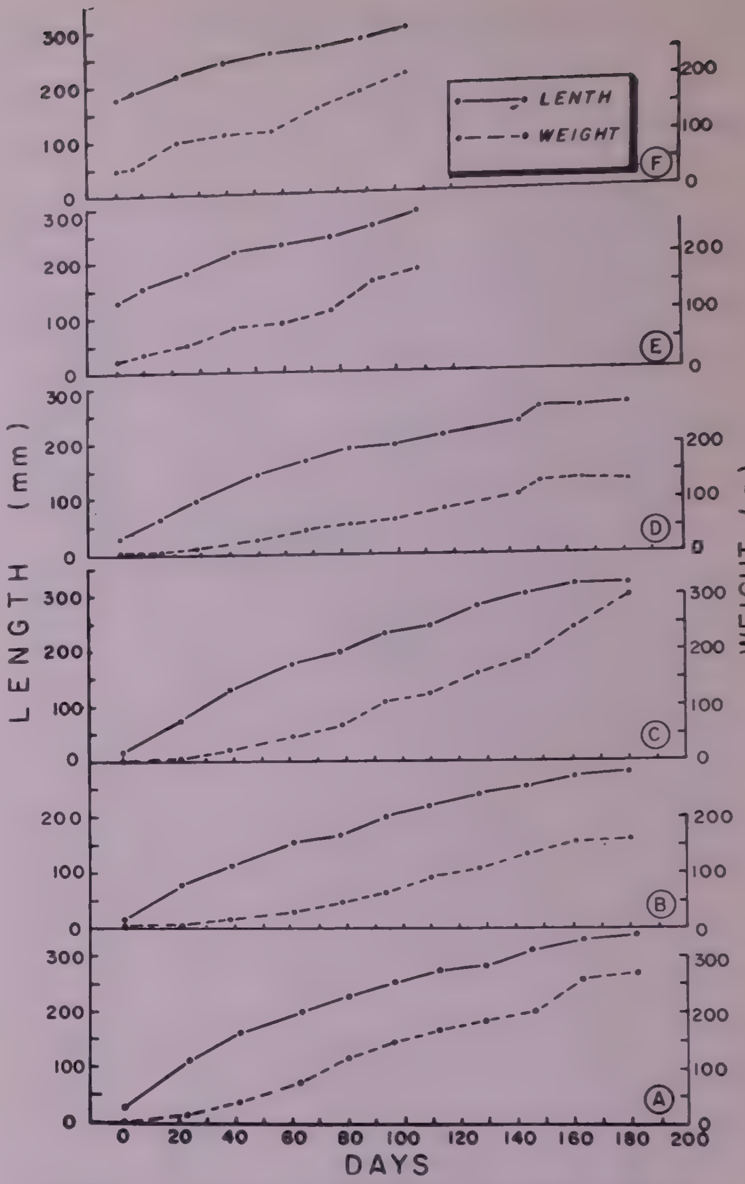

Fig. 2. Growth trends of fish in the different ponds.

Table 1. *Ponds with stocking and harvest details of* Chanos chanos *stocked in* 1983–'84

Ponds	A	B	C	D	E	F
Area (m²)	200	555	1000	220	300	135
Depth of water (m)	1.5	1.5	1.5	1.5	1.5	1.5
Number stocked	200	555	1000	440	300	34
Stocking density (No/m²)	1.0	1.0	1.0	2.0	1.0	0.25
Mean length at stocking (mm)	53.6	16.3	16.3	27.8	130.5	175.3
Mean weight at stocking (g)	1.30	0.045	0.045	0.20	22.5	43.0
Duration of the experiment (days)	182	180	180	181	107	104
Date of stocking	2-7-'83	4-7-'83	4-7-'83	15-7-'83	27-9-'83	30-9-'83
Date of harvest	31-12-'83	31-12-'83	31-12-'83	12-1-'84	12-1-'84	12-1-'84
Mean length at harvest (mm)	332.7	280.3	321.6	259.6	289.4	297.4
Mean weight at harvest (g)	271.4	156.7	256.7	130.4	182.2	209.8
No. of fish harvested	93	493	682	371	297	32
Survival (%)	46.5	88.8	68.2	84.3	99.0	94.1
Quantity harvested (kg)	25.2	77.3	175.1	48.4	54.11	6.8
Production rate (kg/ha)	1,260	1,392	1,751	1,882	1,367	503
Extrapolated level of production (kg/ha/year)	2,527	2.823	3,550	3,795	4,663	1,765

Growth of fish in the ponds

Growth measurements were recorded once in a fortnight by taking a random sample with a cast net. Usually 20 to 30 fish were measured in live condition and were released back into the pond after measurement. Growth trends of fish in different ponds are indicated in Fig. 2. The growth of fish was very good in pond C, followed by ponds B and D. In ponds E and F the growth was poor when compared to the above three ponds. In pond A the growth rate was moderate. In ponds C and B the fishes with a mean size of 16.3 mm were stocked; in pond D it was 27.8 mm. Pond A had a slightly higher stocking size of 53.6 mm and pond E and F got respectively 130.5 and 175.3 mm. The instantaneous growth rate observed for the different ponds are: 1.8219 for pond C, 1.6438 for B, 1.4116 for D, 1.2155 for A, 0.5433 for E and 0.3727 for F. Thus, a decrease in the instantaneous growth of fish was noticed as stocking size increased.

Survival of fish in the ponds

A maximum survival of 99.0% was observed after 107 days in pond E, which had 1.0/m^2 stocking density and 130.5 mm stocking size. This was followed by pond F having 94.1% survival after 104 days of stocking at 0.25/m^2 stocking density and 175.3 mm stocking size. Pond D with a higher stocking density of 2.0/m^2 and stocking size of 27.8 mm gave 84.3% survival rate after 181 days of stocking. In pond B and C, the survival rates were found at 88.8 and 68.2% respectively. These two ponds had same stocking density (1.0/m^2), stocking size (16.3 mm) and culture period (180 days). Pond A gave a survival of only 46.5% even though the stocking density was 1/m^2 and stocking size 53.6 mm (Table 1).

Production rate of fish from the different ponds

The production was good in all the ponds except pond F in which it was 503 kg/ha/104 days. Pond D with 2/m^2 stocking density gave the highest production of 1,882 kg/ha/181 days, which is followed by pond C with 1/m^2 stocking density (1,751 kg/ha/180 days). In ponds B, E and A the production rates were estimated as 1,392/kg/ha/180 days, 1,367 kg/ha/107 days and 1.260/kg/ha/182 days respectively. These ponds had the same stocking density of 1/m^2 eventhough they differed in the stocking size and period of experiment. The mean size at harvest was also remarkable in ponds A (271.4 g), C (256.7 g) and F (209.8 g). In the other three ponds the mean weight at harvest ranged between 130.4 and 182.2 g (Table 1).

Economics of the culture operation

An attempt was made to study the economics of aquaculture operations in polyethylene film-lined ponds in order to estimate the input-output relationships of production (Table 2). It is seen that the greater part (about 80%) has been spent on feed and labour under operational cost. Even with the operational cost of Rs. 6,000/- a net return of Rs. 975/- has been obtained from 0.24 ha area within a period of 6 months. From this it appears that the need is to reduce the operational costs for the venture to be economically viable.

The present results appear to be better than those obtained elsewhere. With all its merits, however, milkfish culture in polyethylene film-lined ponds seems

Table 2. *Economics of* Chanos *culture experiments conducted at Calicut during the year* 1983–'84

(For six ponds (0.24 ha) for six months)

1. Initial investment:	Rs.
Pond construction	1,445
Pump sets	10,000
Hose	2,955
Sheet and lining	8,746
Total	23,147
2. Operational cost:	
Feed	3,379
Seed	253
Diesel and oil	786
Kerosine	190
Labour	1,383
Total	5,991
3. Depreciation:	
Pump sets	603
Hose	369
Sheet and lining	1,093
Total	2,065
4. Total cost:	
Operational cost	5,991
Depreciation cost	2,065
Interest for initial investment (@ 10%)	1,158
Total	9,214
5. Returns:	387 kg
6. Value: Rs. 6,966 (@ Rs. 18.00 per kg)	

Net returns without considering depreciation and interest for the initial investment for an area of 0.24 ha for 6 months: Rs. 975.00.

to be a labour-intensive and expensive operation. Although high production and survival rates have been obtained, the high operational cost has made the returns inadequate. Cost of labour accounts for about 23% of total operational expenses and cost of artificial feed accounts for about 56% of total expenditure. In order to achieve some reduction in these areas, a few suggestions are made here.

A major part of the labour was spent on pumping sea water and this operation was disrupted often due to the roughness of the sea. This can be avoided by selecting the farm site in places where the sea is always calm. Expenditure towards artificial feeding can be avoided by promoting the growth of natural feed in the ponds by way of fertilisation. There are reports which clearly indicate that the milkfish can grow better in ponds with natural feed than with artificial feed.

Remarks

While planning milkfish culture in polyethylene film-lined ponds the following aspects have to be borne in mind. (1) Seed collected from the wild should be well acclimatised to the pond condition before stocking in culture ponds so as to get maximum survival rate. (2) As the stocking size increases, the growth rate of fish decreases. So in order to get maximum growth and production it becomes necessary to stock the *chanos* at a smaller size. preferably when it is 15 to 25 mm size. (3) In the experiments a stocking density of $1/m^2$ has given best result of growth, survival rate and production. (4) A harvesting period between 150 and 180 days after stocking seems to give the best returns.

Fig. 3. A portion of the harvested milkfish.

FORMATION OF SAND BAR AT MADRAS FISHERIES HARBOUR*

Madras Fisheries Harbour was established in 1983 at a cost of Rs. 12 crores and 60 lakhs. It is enclosed by breakwaters on either side with a ground area of 24 hectares and water area of 48 hectares. It has a long jetty of 495 m length and a water depth of 6 m during the low tide. About 50 small trawlers can berth at this jetty. On an average about 150 trawlers go out for fishing from this fishing harbour daily. Regular dredging is done to keep the bar mouth always open.

In the beginning of July, 1986 sand started piling up in front of the outlet and by the end of first week, a sand bar of 2700 m^2 was formed (Fig. 1) leaving only a narrow channel through which only one vessel could pass at a time (Figs. 2–4). The number of trawler units operated decreased to less than 100 during the period and consequently landing of fish also showed a corresponding decrease.

A meeting was organised by the fishermen on 23-7-'86 and a resolution was passed urging the authorities to take immediate steps to clear the sand. The Port Trust started dredging operations from 26–7-'86. By 15-8-'86 the sand was completely removed and normal fishing operations were resumed.

The exact cause for the formation of sand bar is not known. It might have formed due to strong current or drift. During the same period in a fishing village at Kovalam about 40 kilometres south of Madras there was heavy erosion of the coast and many coconut trees which were there for the past 30 or 40 years had fallen. Another unusual phenomenon during the same period was the heavy landing of mackerel in Madras.

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*Prepared by D. B. James, P. Devadoss, S. Chandrasekar, Madras Research Centre of CMFRI, Madras.

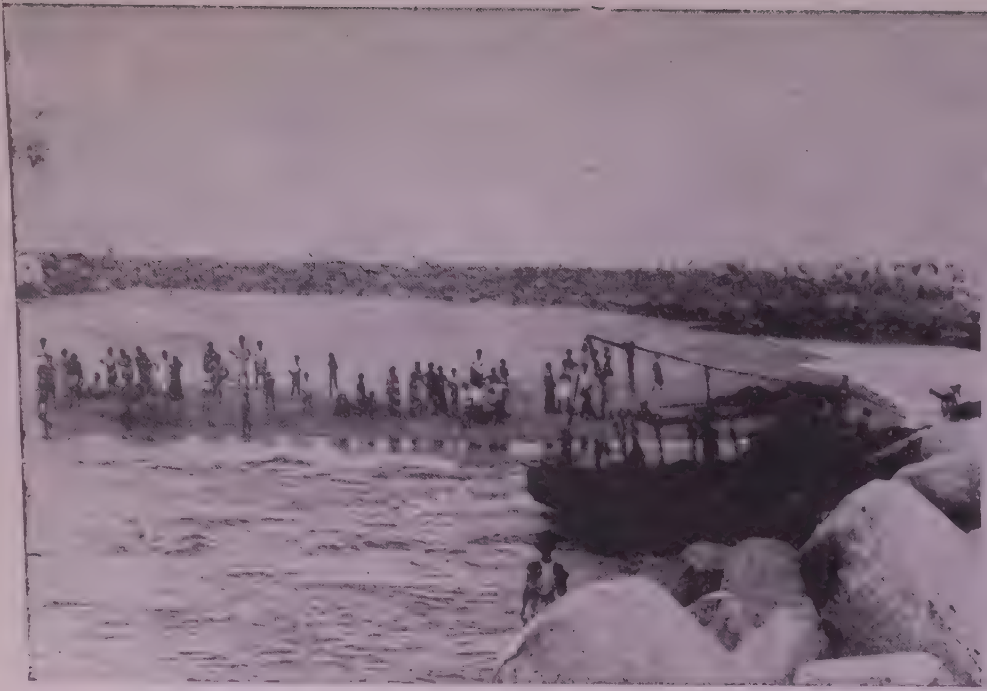

Fig. 1. The sand bar formed at Madras Fisheries Harbour.

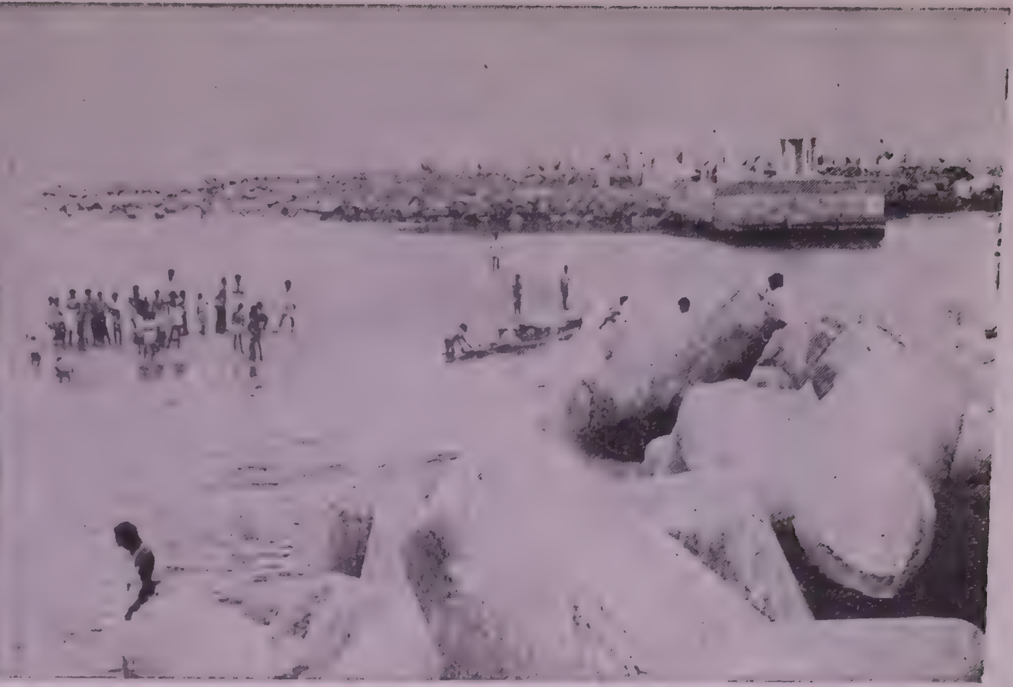

Fig. 2. Another view of sand bar with a catamaran being dragged through the channel.

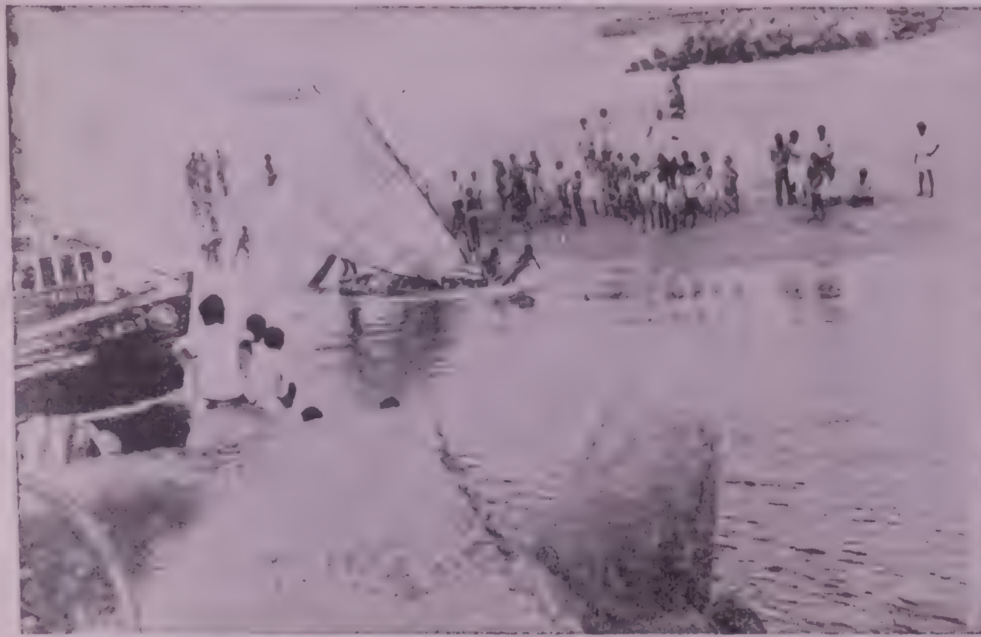

Fig. 3. A catamaran with a sail passing through the narrow channel.

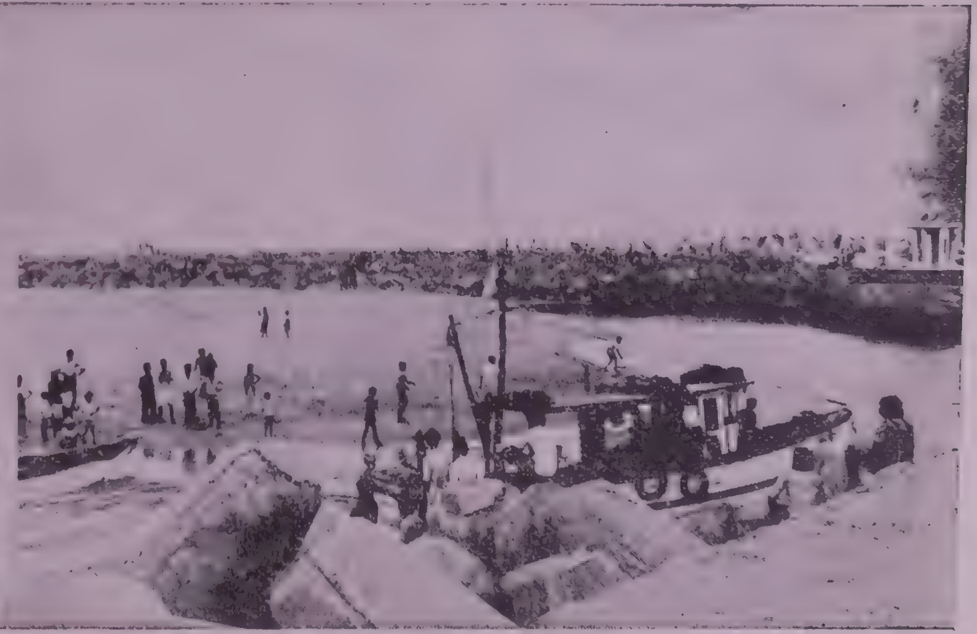

Fig. 4. A fishing trawler passing through the channel.

PRICE STRUCTURE OF THE COMMERCIALLY IMPORTANT SPECIES OF PRAWNS AT MANGALORE*

Introduction

The mechanised trawling has received considerable importance in the last decade due to the increasing demand for prawns by the export industry. Eventhough prawns contribute less than 13.0% of the annual average trawl catch, they realise upto 75.0% of the return in value. Due to this, trawl fishery has been largely dependant on the availability of prawns. In other words, the maximum trawling activity could be observed when peak catches of prawns are available. Though data on catch, effort and biological parameters are being collected on a regular basis, no such data are available on the price structure of prawns of this area. The urgent need to monitor the price structure of commercially important prawns on a regular basis, has been felt for quite some time, since such information is highly essential for the better evaluation and judicious exploitation of this valuable resource. An account on the price structure of the commercially important species of prawns of Mangalore area during 1980–'86 is given in this article.

Commercial species of prawns and their mode of auction

The trawl fishery is largely supported by smaller species like *Metapenaeus dobsoni* and *Parapenaeopsis stylifera*. In addition, larger varieties like *Metapenaeus monoceros, M. affinis, Penaeus indicus* and *P. monodon* occur in fairly good quantities during certain months of the year.

In the case of boats operating during day, generally the prawn catch is sorted out species-wise and kept in separate baskets before they return to the shore. But the boats operating during night bring their catches in iced condition. As soon as the boat is landed, the prawn catch is taken out and auctioned species-wise by The South Kanara District Co-operative Fish Marketing Federation, Mangalore, to fix the rate per kg, provided the unit is financed by it. If the catch is poor, it is auctioned as a lot. The rate fixed for a particular species at an auction is applicable to the concerned catch only. Now-a-days a good number of boats are financed by private parties who in turn take the entire prawn

Table 1. *The price structure (Rs. per kg) during a six year period along with the months of highest and lowest rates for each species of prawns at Mangalore*

Year		*M. dobsoni*	*P. stylifera*	*M. monoceros*	*M. affinis*	*P. indicus*	*P. monodon*
1980-'81	Max.	14.40	10.20	26.40	—	40.00	
	Min.	10.90 (December)	5.50	23.00	23.00 (January)	17.00	S
1981-'82	Max.	16.50	18.00 (January)	30.75	—	71.00	58.00
	Min.	13.00	7.70	26.00	—	32.50	42.50 (November)
1982-'83	Max.	20.00	12.90	39.00	38.00 (May)	76.00	85.00
	Min.	11.50	5.00 (May)	33.20	—	62.00	€8.00
1983-'84	Max.	19.00	14.00	49.00	—	65.00	71.70
	Min.	10.00	9.40	36.00	—	21.00	61.00
1984-'85	Max.	20.00	11.70	40.00	—	65.00	74.00
	Min.	15.50	8.10	21.00	—	18.00 (December)	54.00
1985-'86	Max.	21.60 (March)	17.00	59.00 (March)	—	89.30 (March)	87.50 (March)
	Min.	19.10	15.30	38.00	—	65.00	81.85

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*Prepared by K. K. Sukumaran, Mangalore Research Centre of CMFRI, Mangalore.

catch at a rate slightly lower than the rate fixed by the Federation.

Since there is considerable demand, the price of prawns shows an upward trend season after season. Generally the price for different category of prawns is regulated by the export industry depending on the demand in the foreign market. It is seen that the auctioning rates are always lower than the prices offered by the industry. Slight fluctuations noticed in the rates of a particular species may be attributed to the relative sizes and freshness of the lot auctioned.

Price structure for different species of prawns

The auctioning rates vary from species to species. Even within the species, marginal variations have been observed in the auctioning rates of the catches landed by different boats on the same day. The price structure during a six year period along with the months of highest and lowest rates for each species of prawns at Mangalore is given in Table 1.

General remarks

It is well known that there is correlation among demand, supply and cost of any commercial product. In the case of prawns, on the otherhand, since the supply is always short of demand, the fluctuation in catch has little influence on the price. Moreover, prawns, being an export commodity, prices are always high. Generally exporters decide the maximum price of each species during a particular period. Due to this, any fall or increase in foreign demand will be directly reflected in the local price.

The author is thankful to Shri M. S. Muthu, Scientist S-3 and Head, Crustacean Fisheries Division, Central Marine Fisheries Research Institute, Cochin for kindly going through the manuscript and suggesting improvements.

UNUSUALLY HEAVY LANDING OF KING SEER FISH AT NEW FERRY WARF, BOMBAY*

Unusually large quantity of King seer fish *Scomberomorus commerson* (Lacepede) was landed at New Ferry Wharf fishing jetty at Bombay. The landing of King seer fish, locally known as 'Surmai', started in late September and lasted till early November for about a month. In October, 1986 alone, the landing of this species was estimated to be 2,112.4 tonnes, constituting 26.6% of the total fish catch for the month. The quantity landed during this short period was far greater than the annual average landing of 526.4 tonnes for the past

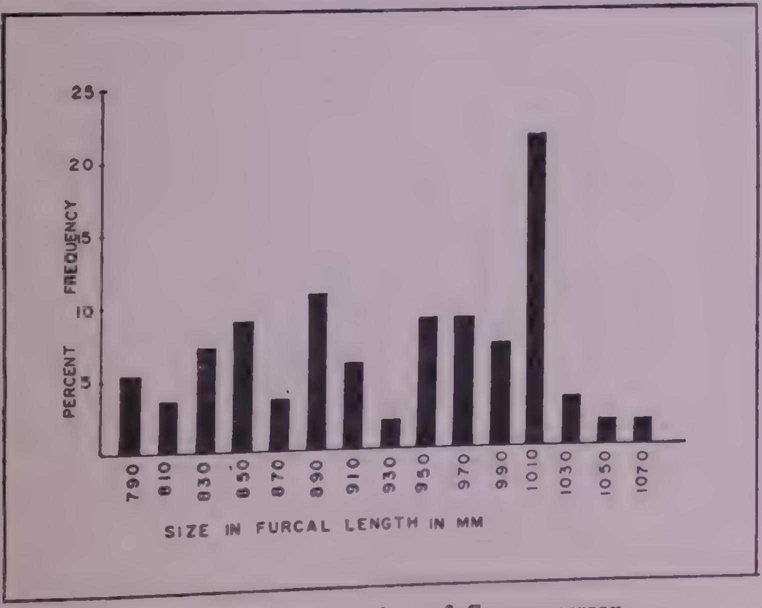

Fig. 1. Size distribution of *S. commerson.*

Fig. 2. Part of the heavy catch of King seer fish landed at New Ferry Wharf, Bombay.

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*Prepared by V. D. Deshmukh and M. Shriram, Bombay Research Centre of CMFRI, Bombay.

three years, which also included the landing of *S. guttatus*, usually a dominant species.

The catch was landed by the trawlers operating at 50–60 m depth off Bassein, an area 60 km north of Bombay. The fishes were caught by means of hooks of size 10 – 15 cm, baited with pieces of *Saurida tumbil* and *Nemipterus japonicus*. About 3–4 hooks were operated from each vessel. Each hook yielded 40–50 King seer fishes per day during the fishing period. On an average, 612 kg of King seer fish were landed by each trawler, but on certain days their catch exceeded 2.5 tonnes per boat trip.

The size of the fish varied from 790 to 1070 mm in furcal length with a dominant mode at 1010 mm (Fig. 1). The weight of fish ranged from 3.1 to 9.7 kg. Examination of few degutted specimens revealed that the ovaries of females were in the spent stage. Their guts were full and showed presence of *Saurida tumbil, Nemipterus japonicus, Apogon* sp. *etc*. The presence of spent ovaries and full stomachs and their falling impulsively to the bait may suggest that this shoal was returning after spawning and had voraceous feeding behaviour.

Due to the unusually large catch the price of King seer fish, which is otherwise quite high (Rs.15–20 per kg) fell to mere Rs. 4–6 per kg. However, this unusual catch benefitted the fishermen by an additional income of about Rs. 3,000 per trip. Most of the catch was bought by the processors for filleting and whole freezing.

THE INDUCED MATURATION AND LARVAL REARING OF THE KING PRAWN *PENAEUS LATISULCATUS* KISHINOUYE UNDER CONTROLLED CONDITIONS*

Introduction

The King prawn *Penaeus latisulcatus* Kishinouye, one of the large-sized penaeid prawns, attains a maximum size of 203 mm in total length. Stray occurrence of its juveniles in the estuaries and backwaters and adults in the inshore seas has been reported from the Indian coasts. However, it supports a fishery of considerable magnitude in Thailand and Australian waters. The eggs and larvae of the species have been successfully reared under controlled conditions in Japan (Shokita, S., *Biol. Mag. Okinawa*, **6**: 34-36, 1970) while a semi-commercial hatchery for seed production has been set up in Australia (Pownall, P.C., *Aust. Fish.*, **32** (12): 2-4, 1973 and **33** (5): 11-14, 1974).

Based on the collection of early juveniles of King prawns from the bar mouth area of Kovalam backwater (Lat. 12°46′ N; Long. 80°18′ E) during May–June 1986, culture of the species was taken up at the Mariculture farm of the Institute, Muttukadu, 36 km south of Madras.

After rearing for two and a half months, a few grown-up specimens were transported to the field laboratory at Kovalam, where the female specimens were subjected to eye ablation treatment. The results of induced maturation, subsequent spawning and larval rearing of the King prawn are presented here.

Broodstock

On the night of 2nd August, 1986, 8 specimens (three impregnated females and five matured males) of the King prawn were collected from the culture pond at Muttukad and transported to Kovalam laboratory and stocked in a one-tonne rectangular fibreglass tank having a layer of (5 cm) fine sand spread over three-fourth of the floor, to suit the burrowing habit of the species. The size of the specimens is given below:

Sl. No.	Total length (mm)	Carapace length (mm)	Total weight (g)	Sex
1	114	28	11.37	Female
2	112	27	11.10	,,
3	108	26	10.66	,,
4	111	24	10.63	Male
5	105	23	8.73	,,
6	118	27	13.15	,,
7	112	24	10.79	,,
8	99	22	8.27	,,

After acclimatising in the broodstock tank for two days, the right eye of the females was removed by using an electrocautery apparatus on 5–8–1986. The broodstock tank was covered with a black plastic sheet throughout the course of the experiment to prevent the penetration of light. Every day, prawns were fed once, at a rate of 20% of their body weight, with fresh backwater clam *(Meretrix casta)* meat at 1730 hrs. The unutilised feed was removed the next day morning. Also, the sediments from the bottom of the tank were siphoned out daily. The little amount of water drawn out along with the sediments was replaced by fresh filtered seawater. Other than this no exchange of water was done. To maintain the pH in the range of 8.0 to 8.2 sodium carbonate was added at a rate of 15 g/m^3 per day for 3 days continuously and thereafter at an interval of 2 days. The salinity of the seawater used in the broodstock tank varied from 33.00 - 34.12‰. The temperature (at 1000 and 1500 hrs) and pH values recorded daily in the broodstock tank during 5-8-1986 to 3-9-1986 are shown in Fig. 7.

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*Prepared by: M. Kathirvel, V. Selvaraj, S. Palanichamy and A. Ramakrishnan, Madras Research Centre of CMFRI, Madras.

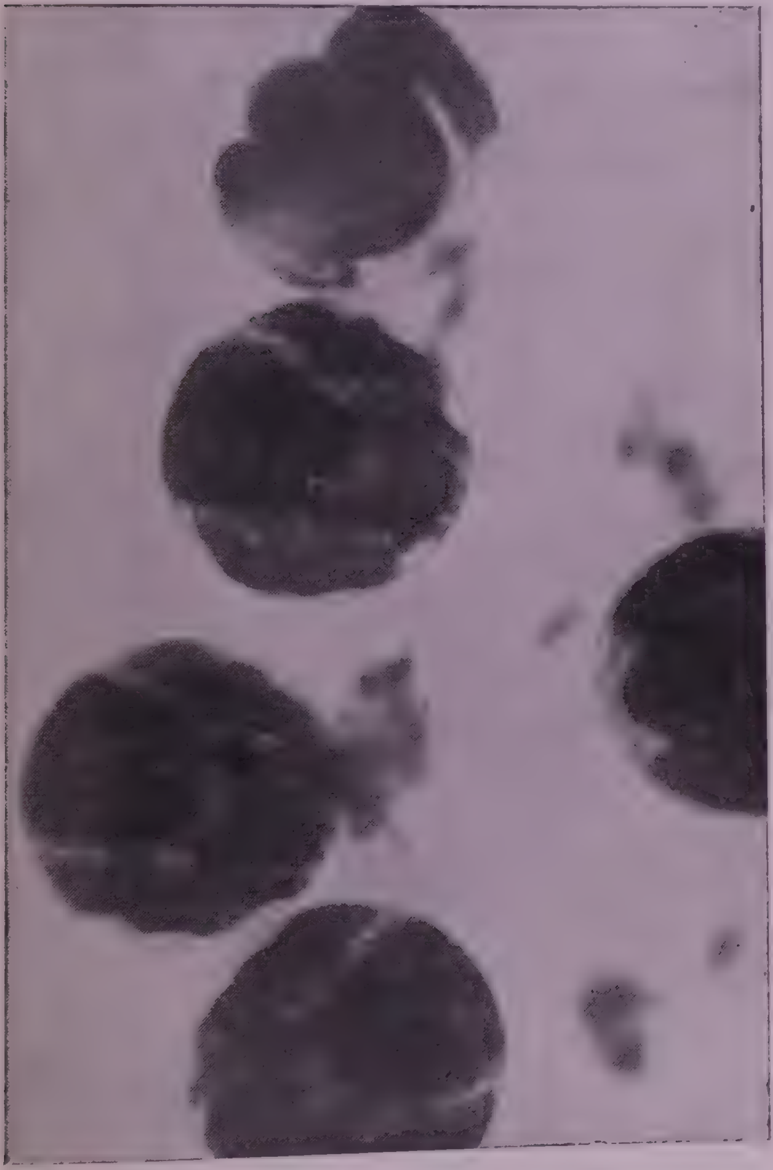

Fig. 1. Eggs with developed nauplius.

Moulting, mating and spawning

All the females (Sl. No. 1 to 3) underwent moulting between 6 and 11 days after ablation, resulting in the loss of the spermatophores in the thelycal plates. However, one of the females (Sl. No. 3) was found with freshly deposited spermatophore after moulting, which could have been the result of the mating by one of the males present in the broodstock tank. During the first 15 days after ablation, no development of ovary was observed. Afterwards, the development of ovary was a slow process. Though the three females appeared with a thin streak of ovary, it was assumed that some more time might be needed for further development. Nevertheless, one female (Sl. No. 2) spawned on 31-8-1986, 25 days after ablation. The spawning occurred in the broodstock tank itself. All the eggs released were unfertilised, as anticipated. The other two females were removed from the broodstock tank and placed individually in 200 l spawning tanks.

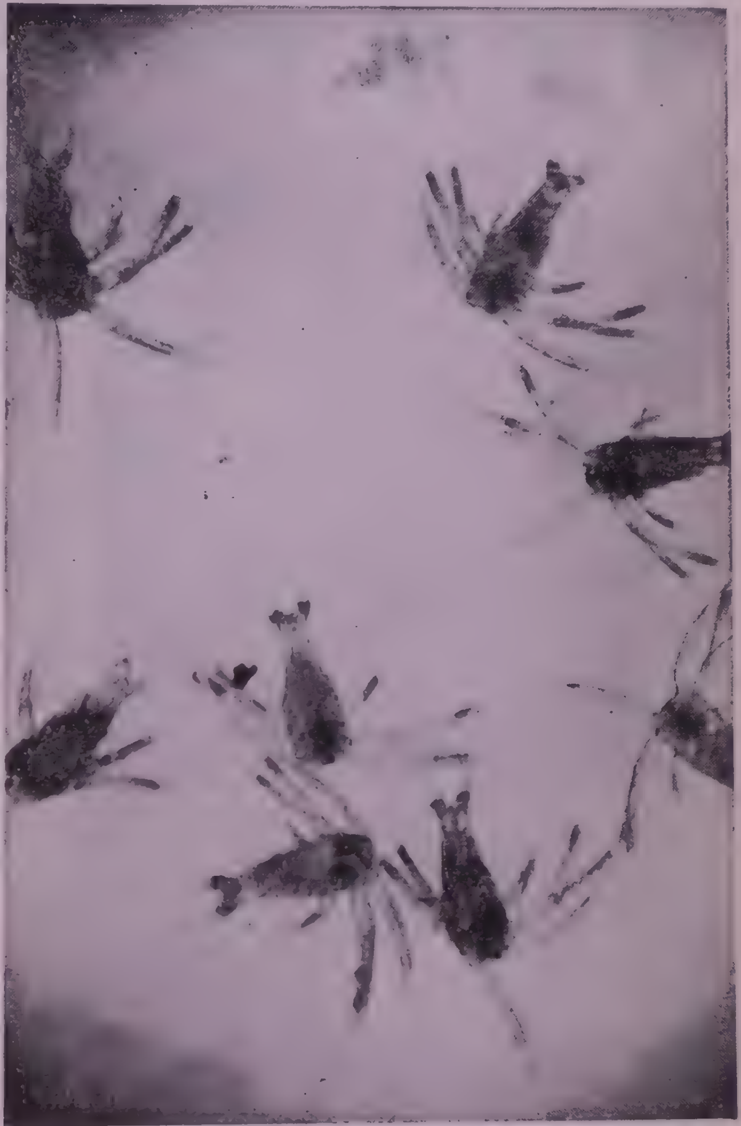

Fig. 2. Group of nauplius VIth Stage

The female (Sl. No. 1) specimen did not spawn, but the absorption of ovary was witnessed. The third specimen (Sl. No. 3) spawned partially at 0230 hrs on 3-9-1986 and released 24,800 viable eggs. The diameter

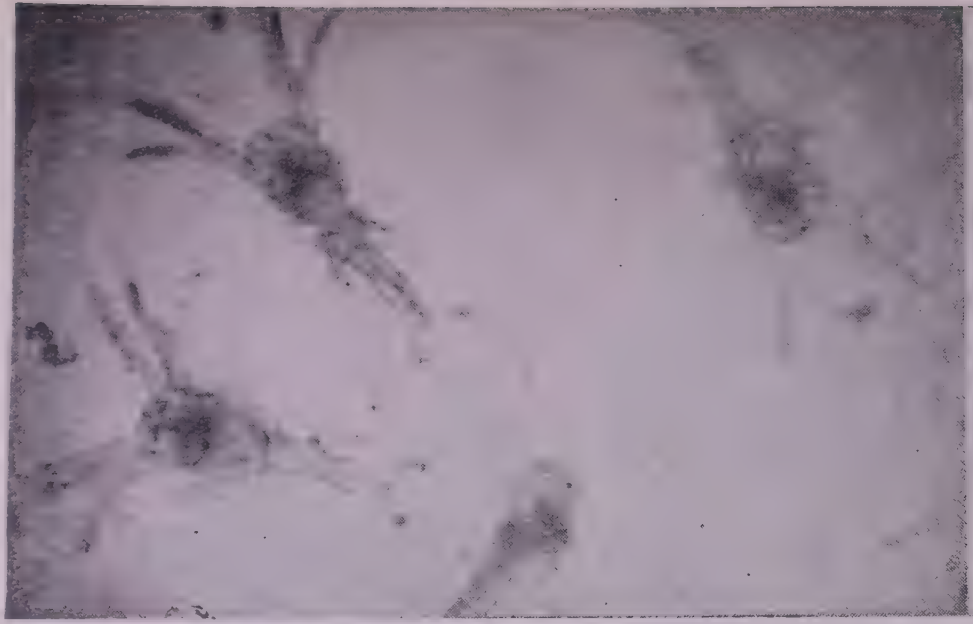

Fig. 3. Protozoea Ist Stage.

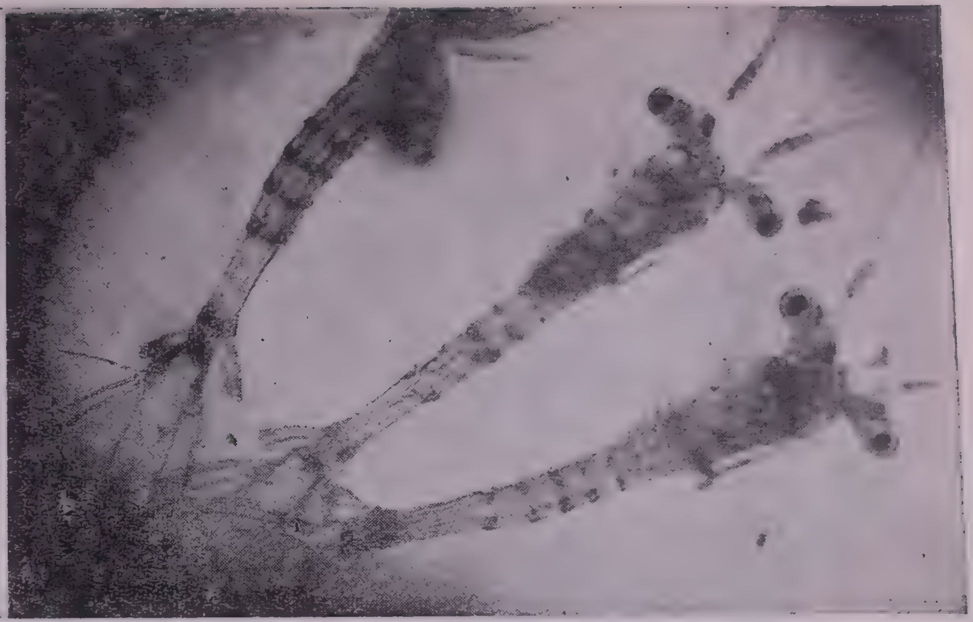

Fig. 4. Protozoea IInd Stage.

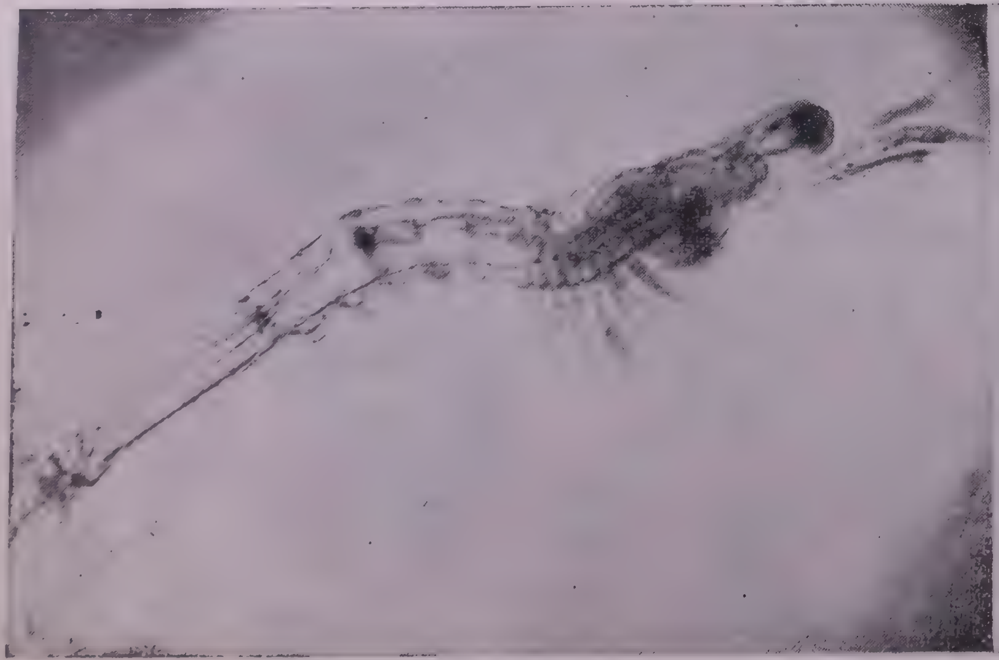

Fig. 5, Mysis IInd Stage.

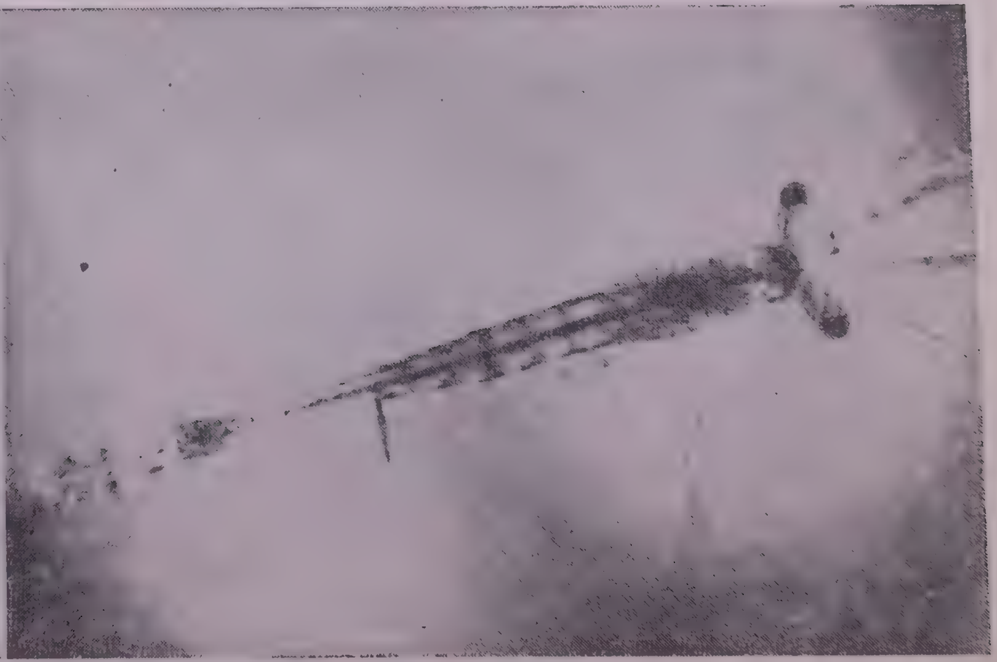

Fig. 6. Postlarva Ist Stage.

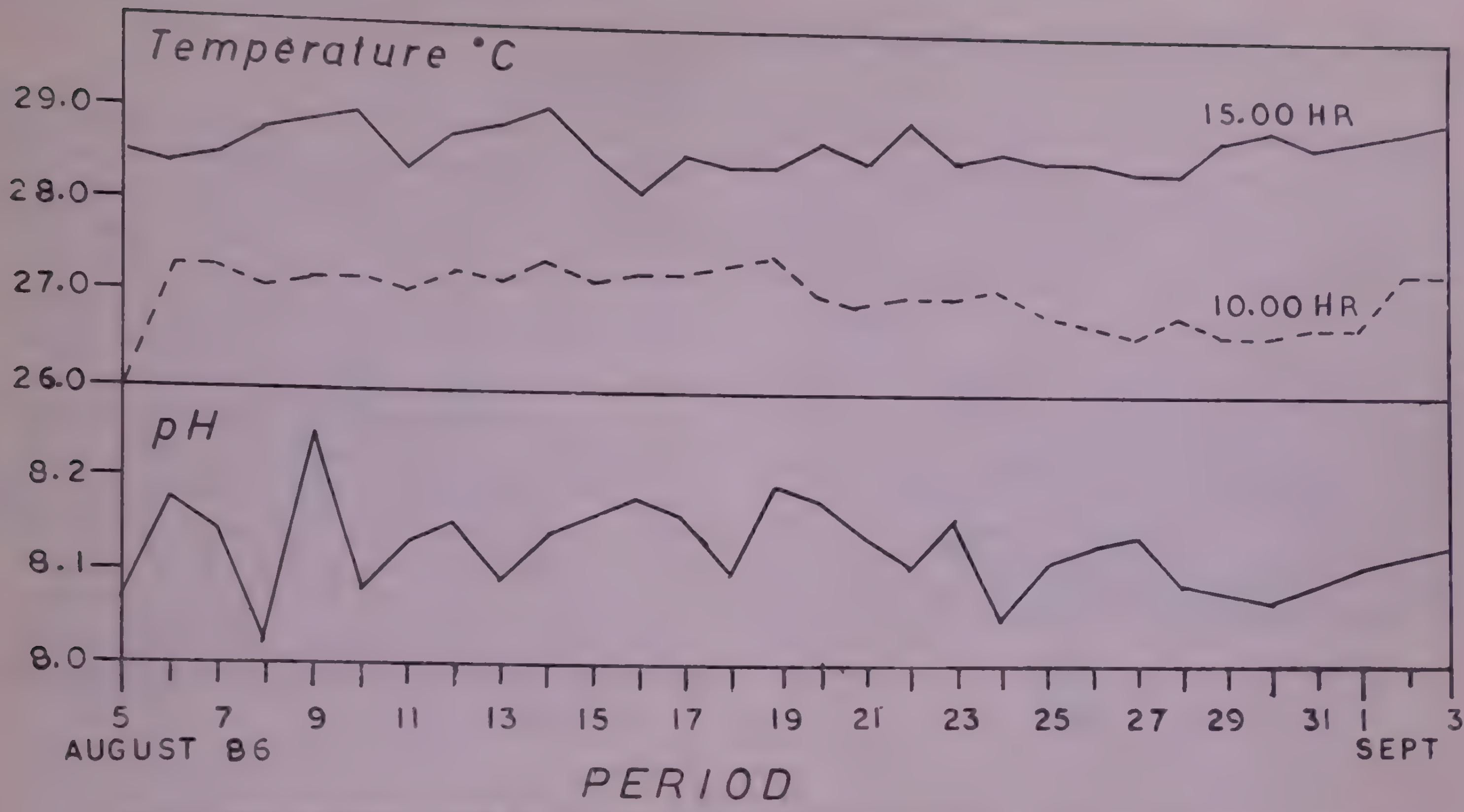

Fig. 7. Water temperature (1000 hrs and 1500 hrs) and pH values recorded in the broodstock tank during the period 5–8–'86 to 3–9–'86.

of eggs varied from 0.263 to 0.280 mm with an average value of 0.270 mm (Fig. 1). The time taken between ablation and spawning was 28 days. Due to the partial spawning and smaller size of the spawner, the number of eggs released was very less. Totally 20,000 nauplii emerged, the hatching rate being 80.6%.

Larval rearing

The hatched out nauplii (Fig. 2) were stocked in a one-tonne rectangular tank. When the larvae metamorphosed to N-6 stage (nauplius), 50 1 of separately maintained unicellular diatom culture (*Chaetoceros* spp.) was provided as the feed for the protozoea 1 larvae (Fig.3). From protozoea I to postlarva I stage (Figs. 4–6), 90 1 of diatom culture was given daily as feed for the larvae.

The temperature in the larval rearing tank was 26.7°C at 0600 hrs but rose to a maximum of 29.8°C at 1400 hrs and afterwards declined to 29.0°C at 1800 hrs, 28.0°C at 2200 hrs and 27.8°C at 0400 hrs. It took 12½ hrs for the development of eggs before hatching. The duration of the substages of nauplius larvae varied from 3 to 5 hrs and that of protozoea 27 to 30 hrs. In mysis stage, it ranged from 26 to 29 hrs. In all, it took 9 days and 1½ hrs to attain postlarva I from the time of spawning.

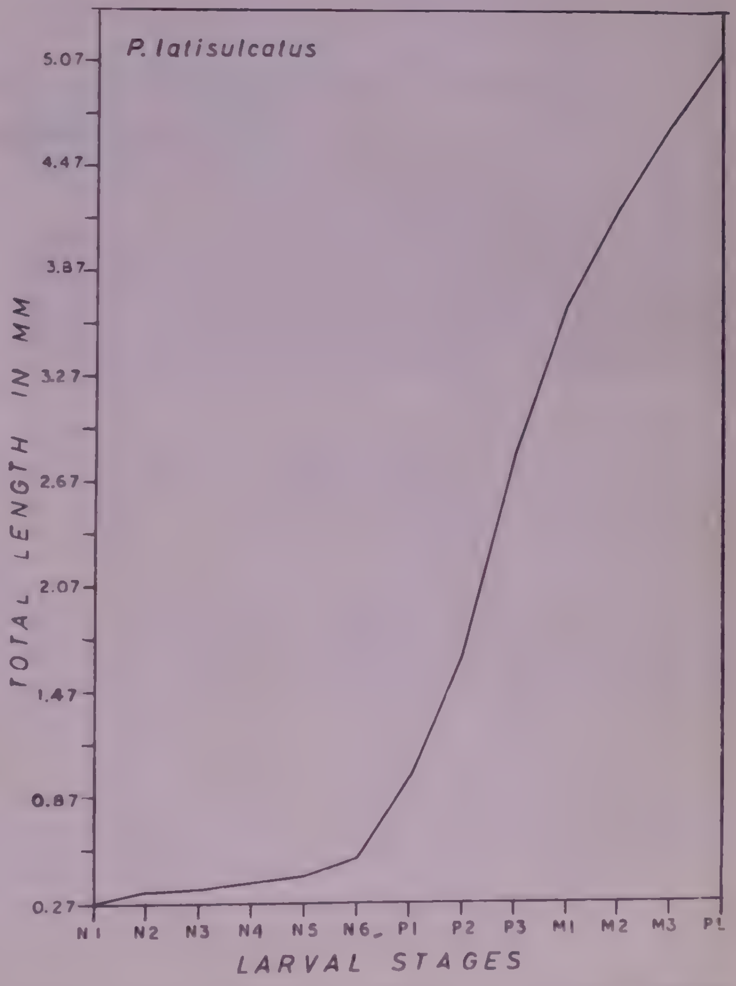

Fig. 8. Growth recorded at different larval stages of *Penaeus latisulcatus*.

Larval growth and survival

At every substage of the nauplius, protozoea and mysis and also at postlarva I, the total length was measured to study the growth during larval development and the average size for each stage is plotted in Fig. 8. In the naupliar stage, 50% increase in length was seen from I to VI stage, while it was 65.6% from protozoea I to protozoea III. However, the growth was less from mysis I to III (22.8%).

The number of larvae that survived in each stage is given below:

Nauplius I	: 20,000
Protozoea I	: 15,950
Mysis I	: 9,780
Postlarva I	: 7,485

Remarks

This is the first time in India that an experiment conducted on the maturation and larval production of *Penaeus latisulcatus* under controlled conditions has yielded fruitful results. The longer duration between ablation and spawning and also lesser number of eggs released may be because of the small size of the prawns. The larvae of King prawn are sturdy brightly coloured right from the naupliar stage. The time taken for the attainment of postlarva I from spawning (9 days at 26.7–29.0°C temperature range) agrees with the results obtained in Japan (Shokita,1970) and Australia(Pownall, 1974). As this species has attained the marketable size of 30 g in 5–6 months of field culture trials conducted in Australia (Pownall, 1974), it is evident that this species could play a promising role in the context of developing marine prawn culture in the coastal waters of our country.

SEA EROSION THREAT TO COASTAL FISHING VILLAGES OF VALSAD DISTRICT, GUJARAT*

Severe sea erosion had occurred in some of the coastal fishing villages like Moti Danti, Nani Danti and Udwada, situated in Valsad District of Gujarat during the monsoon period of 1986 (Fig. 1).

Although sea erosion has been a recurring phenomenon in many of the fishing villages of Valsad District, the erosion was more severe in 1986 compared to those occurred in 1968 and 1976.

The Moti Danti and Nani Danti villages are located as narrow strips of land which jet out into the sea, and fall in the drainage vicinity and mouth of the River Ambika.

In Moti Danti, one portion of the land was completely eroded by the rough sea and also by the heavy rain which made the Ambika River to be in spate and change the course, leading to erosion from the inland portion of the village; ultimately leaving a chunk of land as island. Many of the huts belonging to the fishermen were destroyed. The fish drying yards were also washed away. A few of the damaged huts and the steps taken to foil further erosion by piling stones and sand bags are seen in Fig. 2. It was reported by the village chief that nearly 2.5 sq km area of the village was lost due to sea erosion. The stones piled up for preventing erosion along the coast were also washed away due to high tides during the monsoon season.

The Nani Danti village is located in a sensitive position along the sea coast; and its elevation is slightly higher than the adjacent villages which are said to be below the sea level. Usually during monsoon, paddy is cultivated in Nani Danti and adjacent villages. During 22nd and 23rd June, 1986, due to the high tides, sea water entered through Nani Danti village to the adjacent villages inundating almost 300 acres of paddy fields, inspite of the steps already taken to avert the erosion by piling up stones and sand bags (Fig. 2).

The dwellings of fishermen, fish drying yards and standing paddy crop were damaged. It may be also

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*Reported by A. P. Lipton, S. G. Raje and M. Chellappa, Veraval Research Centre of CMFRI, Veraval.

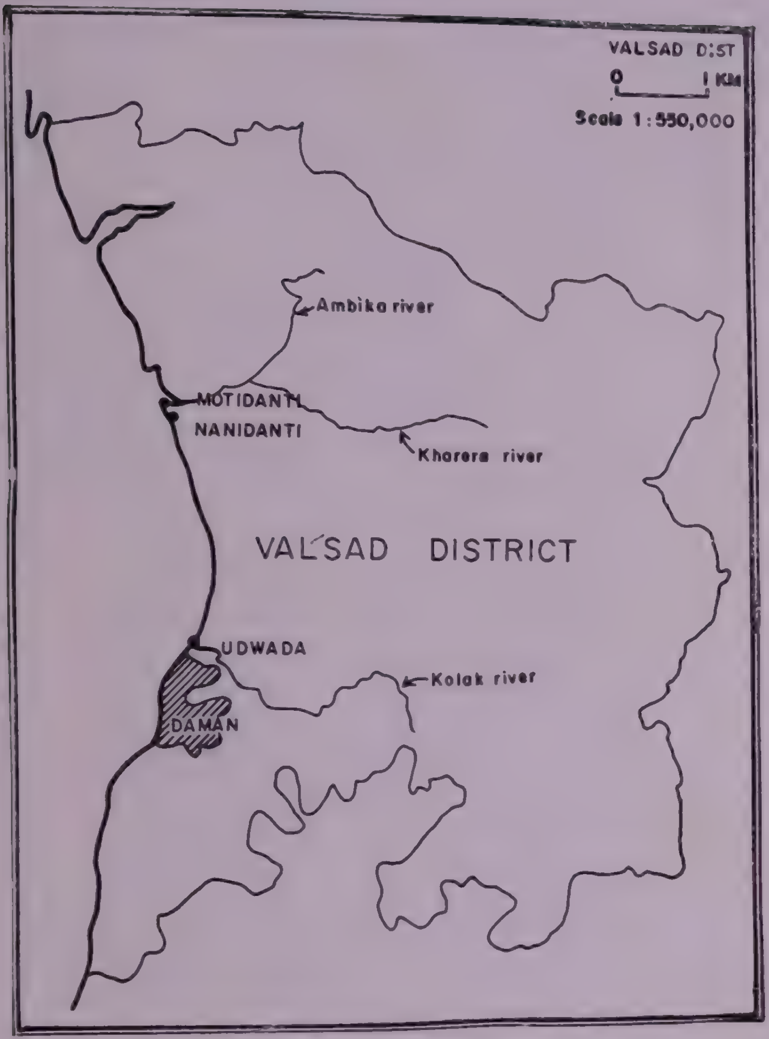

Fig. 1. The coastal villages in Valsad District where sea erosion took place.

Fig. 2. A view of Nani Danti village where severe sea erosion took place.

noted that the effect of salt water would adversely affect the paddy crop in the ensuing seasons also.

In Udwada village, severe land erosion occurred in June, 1986. In the past several years, there has been continuous and progressive incursion of sea towards this village. It could be seen from Fig. 3 that many of the buildings near the sea coast are on the verge of collapse due to erosion. The elders in this village reported that about 25 years back, the sea was more than 100 metres interior to the present coast line. Due to the continuous erosion, several families of Udwada have migrated to other safer places during the past few years. The adjacent villages such as Kolak and Maroli are also under the grip of sea erosion.

Fig. 3. The sea has entered far interior into village.

Fig. 4. Another location of severe sea erosion.

It is felt by the villagers that if timely effective steps are not taken to stop erosion, the sea may enter into many of the villages near Nani Danti such as Kakawadi Danti, Methia, Bonsri, Dholai, Malwan, Karwa, Kardiwa, Mutali, Durasana and Dungis which are situated below sea level and may adversely affect the crops and other cultivations in the years to come.

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NOVEMBER 1987

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4. Introduction of mechanised-cum-sail crafts at Kakinada
5. Newfangled tackles for cephalopods
6. Recovery of a ringed 'Dusky shark' *Carcharhinus obscurus*

Front cover photo:

A view from the sea, of the lagoon and exposed coral reef of Bangaram Island, Lakshadweep. Note the waves striking against the reef and against the sandy beach in the background.

Back cover photo:

Tunas are being cut and prepared for making 'masmin' in Agatti Island, Lakshadweep.

SMALL-SCALE POLE AND LINE TUNA FISHERY IN LAKSHADWEEP – PRESENT TREND, CONSTRAINTS AND STRATEGIES FOR FUTURE DEVELOPMENTS

P. S. B. R. James, G. Gopakumar* and P. P. Pillai**

Central Marine Fisheries Research Institute, Cochin

Introduction

The mainstay of the tuna fishery of the Lakshadweep Islands is the small-scale pole and line fishery. It includes chumming with live-baits to attract and hold tuna schools close to the vessel and hooking by pole and line. The advantages of this type of fishing are: relatively small capital investment involved, ability to harvest small schools of fish, mobility to operate from small ports with minimum technical support and the ability to utilise unskilled labour. In Lakshadweep, as observed by Jones (1986), since the land and its resources are very limited, optimum exploitation of the resources of the vast expanse of its oceanic waters is the solution for furthering the development of the islands and the economy of the islanders. The introduction of mechanisation of the fishing boats in the early sixties and the extension of small-scale pole and line fishing which was traditionally in vogue only at Minicoy Island to some of the northern islands such as Agatti, Suheli Par and Bitra are the two recent developments in this direction.

The resource

Production of tunas (chiefly Skipjack and young Yellowfin) by pole and line fishery in the Indian Ocean and in the countries neighbouring India such as the Republic of Maldives and Sri Lanka during the period 1981-'85 is presented in Fig. 1. Total tuna production by this fishery in the Indian Ocean recorded an increase of about 40% from 1981–'85 and the Republic of Maldives contributed to 90.2% and Sri Lanka 5.6% of the total production (IPTP/FAO, 1986). Mechanisation of the traditional crafts engaged in the pole and line fishery has been instrumental for the increase in catches. Fish production in the Lakshadweep has increased from 2,570 tonnes in 1976 to 4,700 tonnes in 1985, of which tunas, especially Skipjack tuna *(Katsuwonus pelamis)* contributed 1,300 tonnes and 3,800 tonnes respectively in these years (Fig. 2).

Scientific estimates of potential resources of tunas in the Lakshadweep Sea, based mainly on the primary production and catch statistics indicate that they vary between 50,000 tonnes and 1,00,000 tonnes, and resource availability is not a constraint in the development of tuna fishery in this area. According to the recent estimation by Chidambaram (1986) the fishery potential in the southwest region of the Exclusive Economic Zone of India is 1.15 million tonnes, of which 90,000 tonnes are formed by tuna resource. James (1986) presented an exploitable potential of 5,00,000 tonnes of oceanic resources including tunas, pelagic sharks *etc.* from the area. This coincides with the observation by Silas and Pillai (1985) that tunas remain to be one of the least exploited resources of the Indian seas, and in 1984 it formed only 1.25% of the total marine fish landings in India.

Development of domestic small-scale fisheries and national harvesting capabilities become important to ensure rational exploitation of fishery resources in the Exclusive Economic Zone. As opined by Varma *et al.* (1986) an initial moderate scale of development by expanding pablo-boat fishery using traditional fishing methods can be encouraged in view of their efficiency and other advantages. It has earlier been suggested that for augmenting tuna production in the developing countries like India. expansion of surface fisheries is the prime means (Silas and Pillai, 1982; 1986). Introduction of highly mobile, large-scale purse seining is not a prudent proposition since it is capital intensive and may not provide local employment and also require shore based infrastructure facilities such as berthing and bunkering jetties, large scale freezing and canning

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** Minicoy Research Centre of CMFRI, Minicoy.

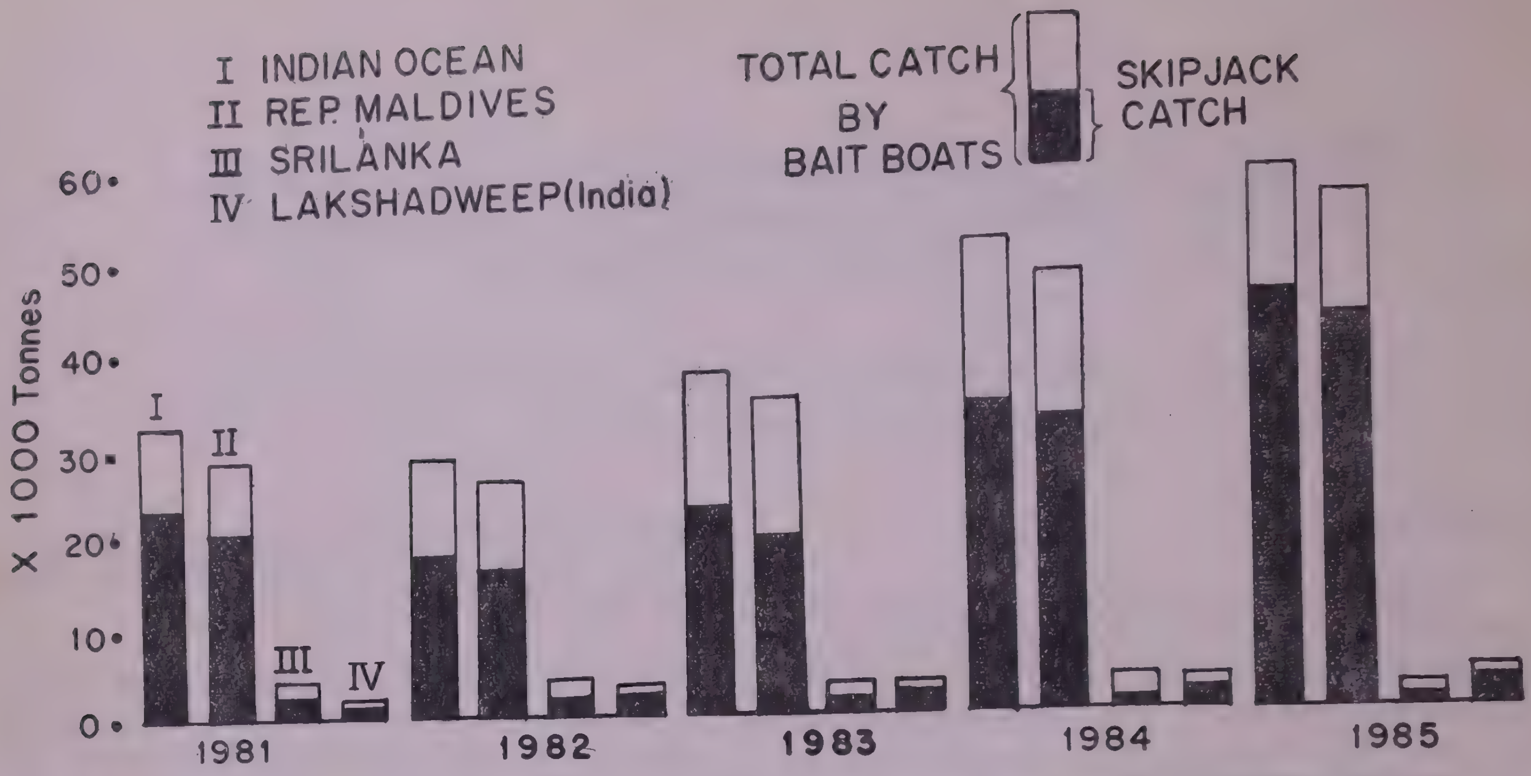


Fig. 1. Production of tunas by pole and line (bait-boat) fishery in the Indian Ocean, Republic of Maldives, Sri Lanka, and India 1981–'85. Shaded portions indicate composition of Skipjack tuna in the total catch.

facilities *etc.* Hence it is felt that one of the immediate steps which appears practicable and feasible for the development of surface fishery for tunas within our EEZ is the strengthening and expansion of the small-scale pole and line fishery and the introduction of medium sized purse seiners especially in the northern islands.

According to Varghese (1986), a fishery providing self employment to nearly 5,000 people has been established in the Lakshadweep with the necessary infrastructure. About 300 mechanised fishing boats operate in this area landing over 5,300 tonnes of tunas and other fishes annually, adding about, 2.5 crores to the income of the islands, with a per capita fish availability of over 100 kg.

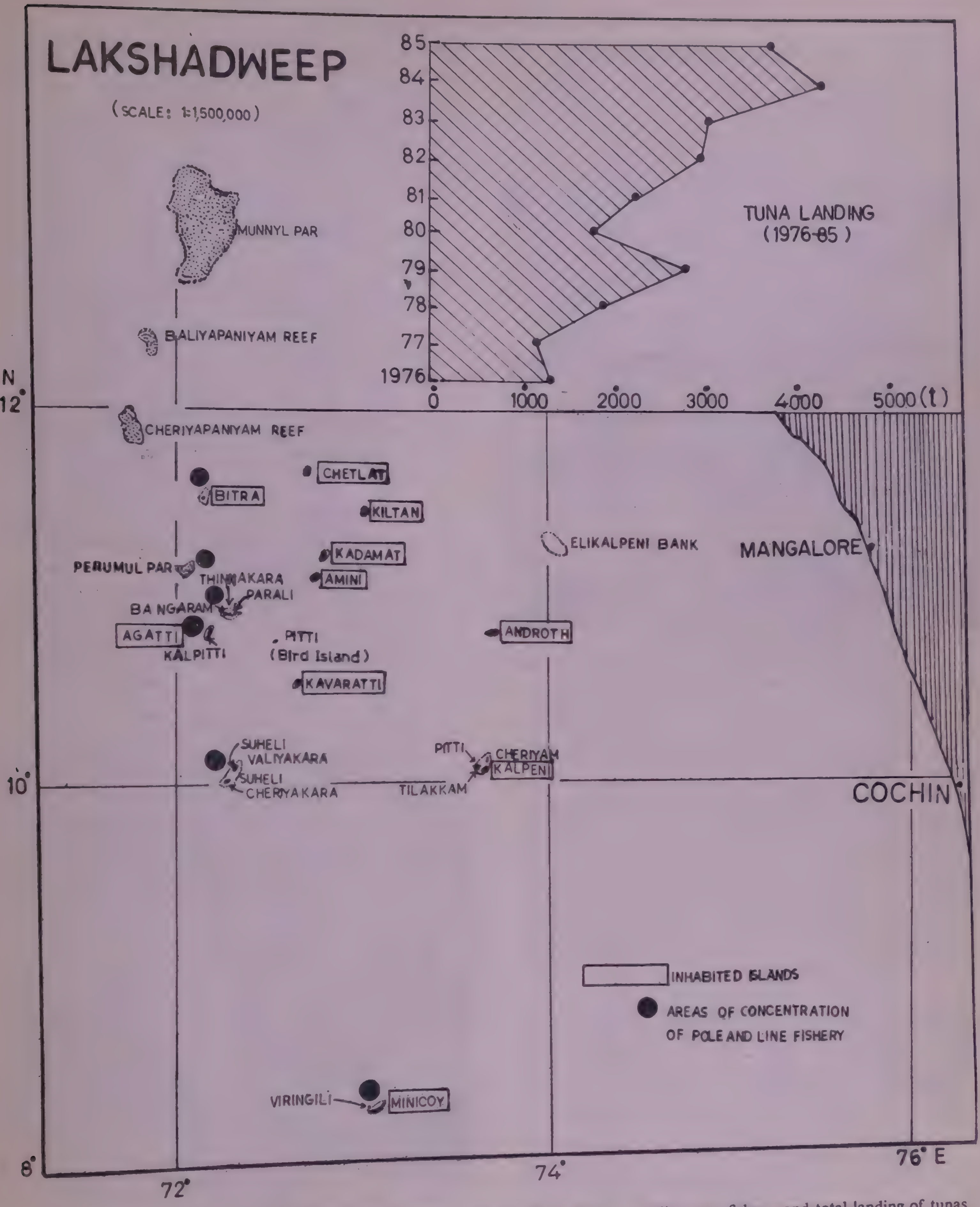
The small-scale fisheries development requires in most cases special support from the administration. An integrated approach with the participation of fishing communities involved in fish production and marketing, and scientists involved in research and development is probably the best way of channelising technical, financial and other forms of assistance. In this context, it is felt opportune to outline the present trend, constraints and prospects for further development by designing and adopting technologies appropriate to local conditions, which would assist the policy planners involved in the development of tuna fishery in Lakshadweep.

Present trend

The pole and line fishery at present is concentrated mainly at Agatti, Bangaram, Perumal Par Reef, Minicoy, Suheli Par and Bitra islands of Lakshadweep.

At Agatti, pole and line fishery including the mechanisation started in early 1960. On an average 50 pole and line boats operate for about twenty fishing days in a month at Agatti during the active fishing months *viz.* November to April. The total average annual effort is about 6,000, yielding about 1,800 tonnes of tunas with an average catch per boat of 300 kg.

There is further prospect of developing the small-scale pole and line fishery around Agatti due to the added advantage of availability and abundance of live-bait fishes from the nearby lagoons of uninhabited islands and islets like Bangaram, Tinnakara, Parali and Perumal Par Reef. The shallow sandy areas of the lagoons of Agatti, Bangaram and Perumal Par harbour a rich resource of the common live-bait fish *Spratelloides delicatulus,* which is the only live-bait fish exploited at present. Recent exploratory live–bait resource survey, conducted by scientists from Central Marine Fisheries Research Institute, at Minicoy and Agatti (November–December, 1986) in the deeper parts of the lagoons of the above mentioned islands using lift nets operated by poles revealed that the above


LAKSHADWEEP
(SCALE: 1:1,500,000)
TUNA LANDING (1976-85)
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84
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CHERIYAPANIYAM REEF
CHETLAT
BITRA
KILTAN
KADAMAT
AMINI
ELIKALPENI BANK
MANGALORE
PERUMUL PAR
THINNAKARA
PARALI
BANGARAM
AGATTI
KALPITTI
PITTI (Bird Island)
ANDROTH
KAVARATTI
SUHELI VALIYAKARA
SUHELI CHERIYAKARA
PITTI
CHERIYAM
KALPENI
TILAKKAM
COCHIN
INHABITED ISLANDS
AREAS OF CONCENTRATION OF POLE AND LINE FISHERY
VIRINGILI
MINICOY
N
12°
10°
8°
72°
74°
76° E

Fig. 2. Topography of islands in the Lakshadweep, areas of concentration of pole and line tuna fishery, and total landing of tunas in the Lakshadweep, 1976–'85.

lagoons also inhabit unexploited live-bait resources of apogonids, pomacentrids and caesionids which can sustain a moderate fleet of small-scale pole and line fishing boats *(Appendix)*.

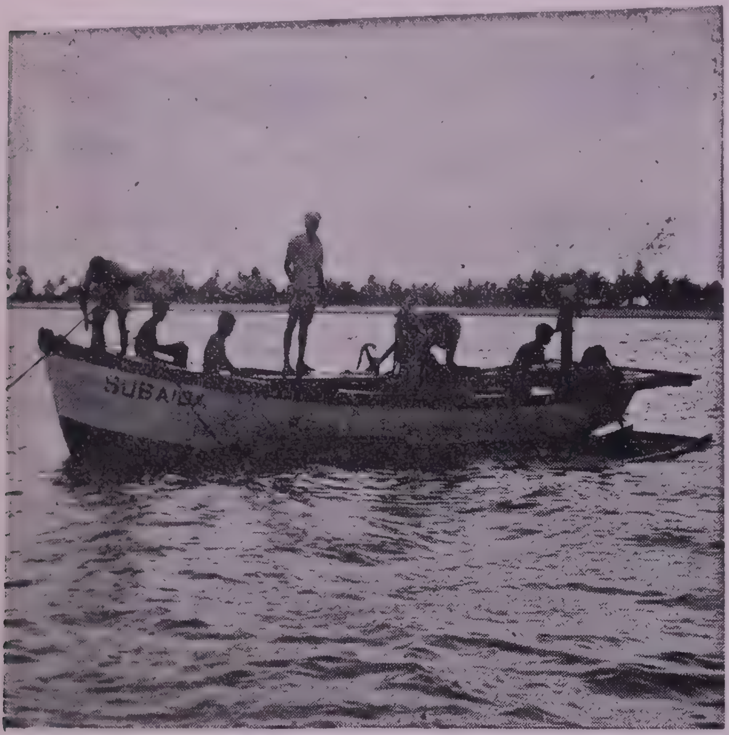

Fig. 3. A pole and line tuna fishing boat with bait baskets alongside the boat at Agatti Island.

The fishermen at Agatti go out for pole and line fishing to nearby islands and islets like Perumal Par Reef, Suheli Par, Bitra, Pitti, Cheriyapaniyam Reef and Baliyapaniyam Reef, when the tuna schools are not obtained around Agatti and Bangaram. This is an added advantage for the fishermen at Agatti, as compared to those at Minicoy, who are not able to move out of the vicinity of the island without navigational aids, due to the isolated geographical location of the Minicoy Island.

Biological examination of Skipjack tuna landed at Agatti indicates that they occur in the fishery in the size range of 32–68 cm. Two major modes at 46 and 64 cm representing one and two year olds respectively are recorded.

As to the economy of tuna fishery, the fixed capital involved in pole and line tuna fishing is the cost of the hull, engine and accessories which comes to about Rs. 1,25,000/-. The cost of gear which includes the bait net, poles, lines and hooks comes to about Rs.2,500/- annually. The operational expenditure for a pole and line boat at Agatti for a fishing season, which includes the cost of diesel, lubrication oil and the food and refreshment charges of the crew (120 fishing days on average ten hours running per day for engine and for 9 fishing crew) is about Rs. 25,000/-. The average maintenance cost of hull, engine and gear is about Rs. 5,000/- per fishing season. All the expenditure is borne by the boat owner. The price of *masmin* at present is about Rs. 30 to 40 per kg. (Source: Planning Department, Secretariate, Lakshadweep, Kavaratti – Revised Seventh Five Year Plan 1985–1990, Sector – Introduction, 1987). The average *masmin* produced per boat during a fishing season is about 6 t, the revenue from which comes to about Rs. 1,80,000/- at the average rate of Rs. 30 per kg of *masmin*. Half of the revenue is the share of the boat owner and the rest is shared by the crew (usually nine). It is worth mentioning that there is no indebtedness or middlemen problem at the islands.

Minicoy: Detailed information on the pole and line tuna fishing and estimates of stocks of Skipjack and Yellowfin tunas at Minicoy in recent years are available (Madan Mohan *et al.*, 1985; Silas *et al.*, 1986a, b; Gopakumar *et al.*, 1986 MS and James *et al.*, 1986). Estimates of the effort expended, catch and catch per boat are presented below for the period 1984–'85 and 1985 -'86 for comparison.

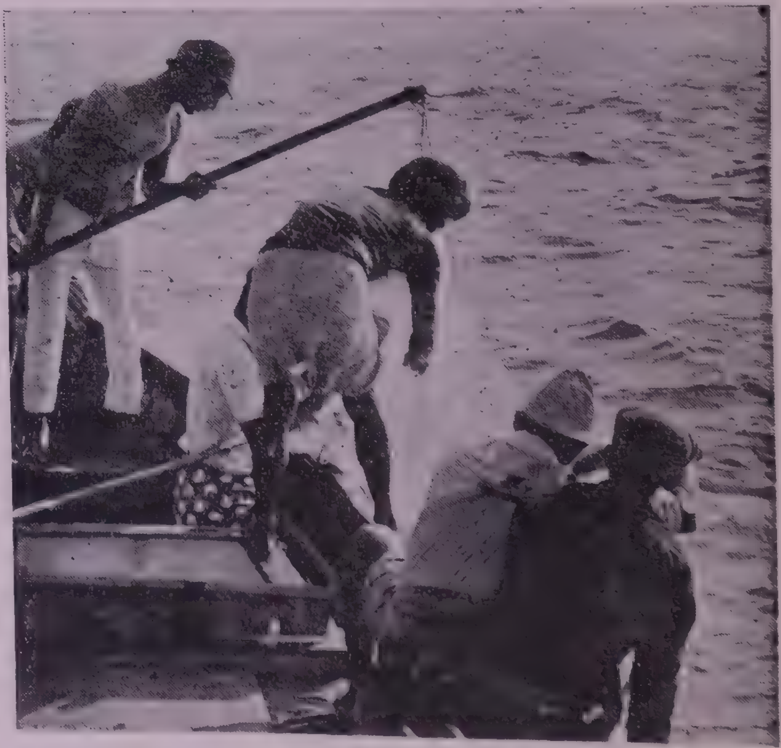

Fig. 4. Live-bait fishing using lift net.

In both the year, the Skipjack tuna occurred in a wide range of size 30–70 cm with two dominant modes

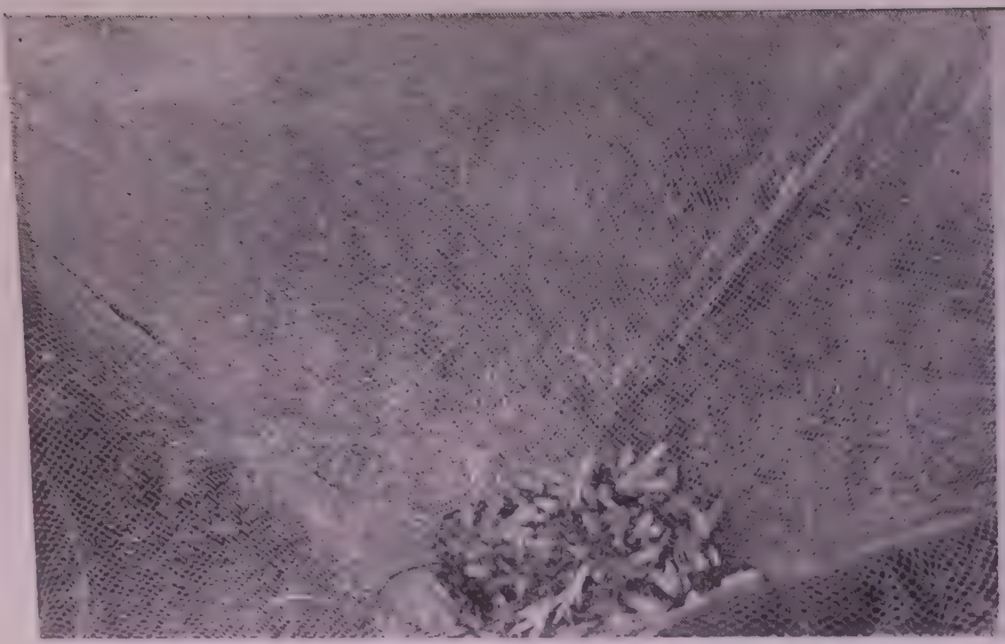

Fig. 5. Live-baits caught in a haul of the lift net.

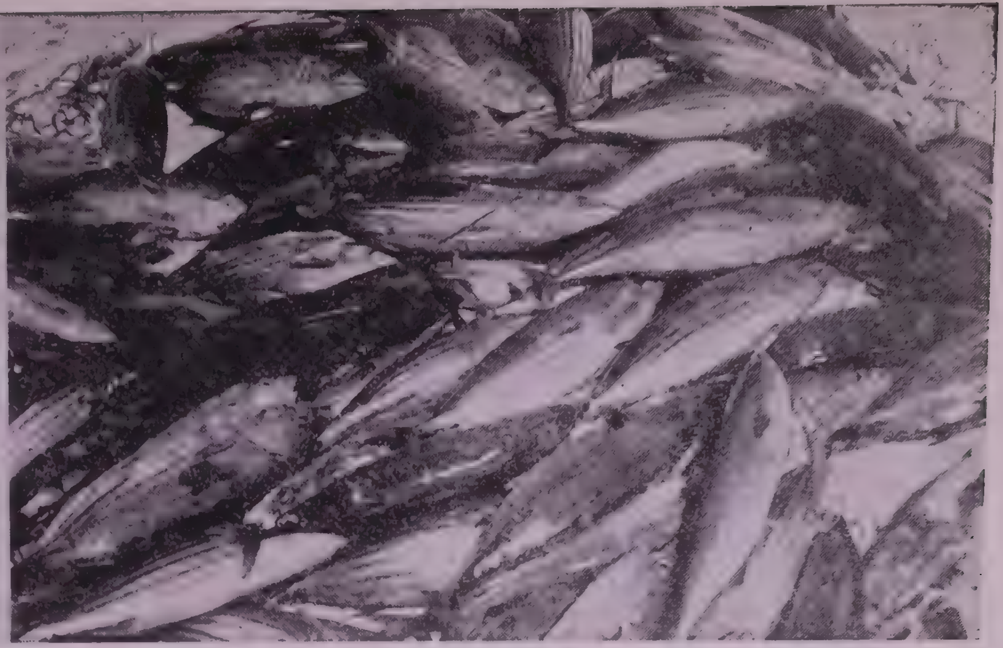

Fig. 6. A catch of Skipjack tuna brought to the shore.

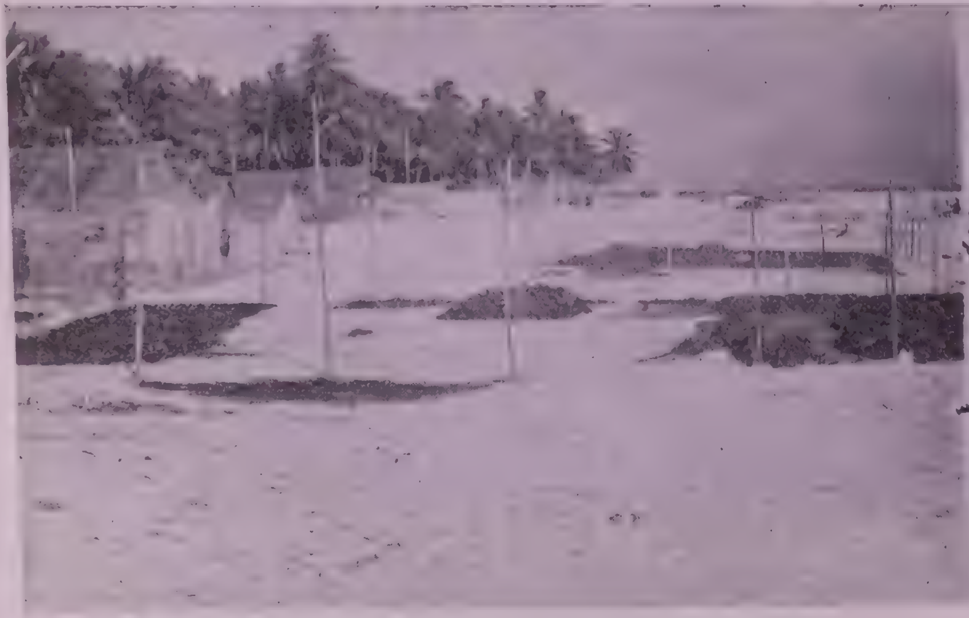

Fig. 7. A view of 'masmin' being prepared in Bitra Island.

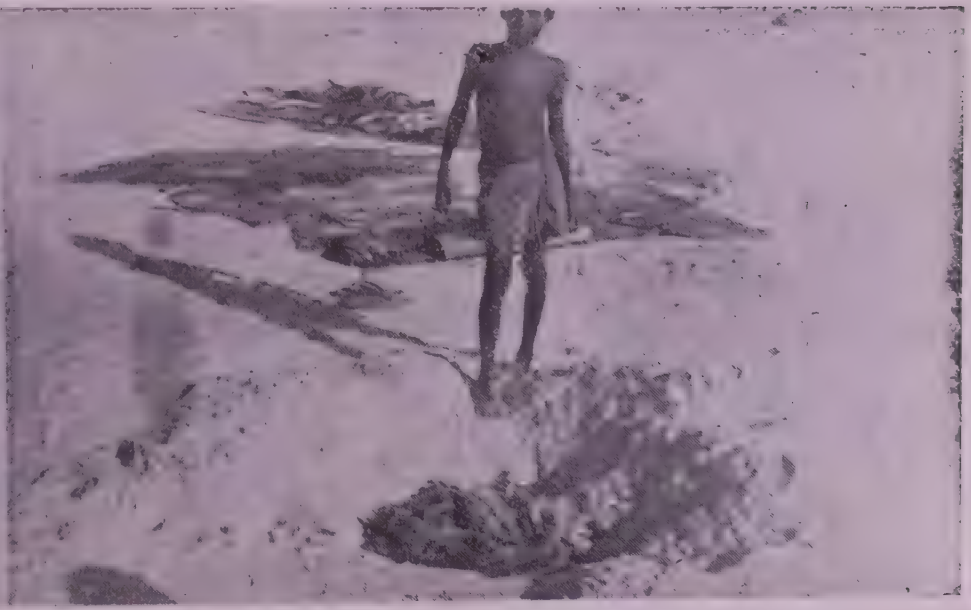

Fig. 8. Fish wastes are simply buried on the beach in Bitra Island and this is a major health hazard in the Island.

at 53 and 63 cm representing one year and two year old groups respectively. The estimated total mortality rate of Skipjack tuna was 1.89. The standing stock and average annual stock of this species from the average catch of the two years were 455 and 1,013 tonnes respectively. The yield per recruit analysis showed that there will be increase in yield with the increase in effort, and the present level of exploitation may not affect the stock.

Year	Effort (boat trips)	Catch (tonnes)	CPUB (kg)	Skipjack (%)
1984–'85	2,649	633	240	94
1985–'86	2,601	686	264	89

Tuna fishing from schools associated with flotsam was studied at Minicoy (Madan Mohan, 1985; Gopakumar *et al.*, 1986, MS). During 1984-'85 season fifteen boats fished from these schools, and caught about 9,045 kg of tunas with a catch per boat of 580 kg. The Yellowfin tuna, *Thunnus albacares* dominated the catch (70.0%) followed by *K. pelamis*. During 1985-'86, 81 boats fished from schools associated with flotsam and caught 95 tonnes of tunas with a catch per boat of 1,176 kg. *K. pelamis* dominated the catch (50.6%) followed by *T. albacares* (48.6%). Two advantages of fishing associated with flotsam are its high catch rate and effective returns per unit of bait (in kg) used for the fishery.

Studies in the recent past on tuna live-bait fishes (Madan Mohan and Kunhikoya, 1986, MS; Pillai *et al.*, 1986; Gopakumar *et al.*, MS, 1986) and the baitfish resource surveys conducted recently throw more light on their occurrence and seasonal abundance at Minicoy (*Appendix*). Eventhough, *S. delicatulus* is the most dominant single species of live-bait fish employed for the tuna fishery, it constitutes on an average about 40% of the total baitfish catch at Minicoy. The rest of the bait catch is composed of the other species of sprat, *S. gracilis*, pomacentrids like *Chromis caeruleus*, *C. nigrurus*, *C. ternatensis*, *Pomacentrus pavo*, *Lepidozygus tapeinosoma*, apogonids such as *Apogon sangiensis*, *Archamia fucata*, *Rhabdamia gracilis* and caesionids like *gymnocaesio argenteus*, *G. gymnopterus*, *Caesio caerulaureus*, *C. xanthonotus*, *Pterocaesio tile*, *P. pisang* and atherinids such as *Pranesus pinguis*. At Minicoy, the fishery by pole and line started from time immemorial, and the traditional practice of collecting *S. delicatulus* and other deeper species which was in vogue in the Maldive group of islands was adopted at the time of introduction of this fishery at Minicoy, which is followed even now. This is in striking contrast to the other pole and line tuna fishing islands of Lakshadweep, where only *S. delicatulus* is being caught and used as live-bait. At Minicoy, during 1984–'85 season, a total of 5,595 kg of live-bait fishes were caught of which *S. delicatulus* formed 36.1%, *S. gracilis* 7.8%, *Dussumieria hasselti* 2.2% *Chromis caeruleus* 2.1%, *Lepidozygus tapeinosoma* 0.5%, *Caesio caerulaureus* 18.5%, *C. chrysozona* 12.9%, *Gymnocaesio argenteus* 12.2%, *Apogon sangiensis* 2.1%, *Rhabdamia gracilis* 1.1% and *Archamia fucata* 1.8%. In 1985-'86 season, a total of 5,051 kg of live bait fishes were caught of which *S. delicatulus* formed 22.6%, *S. gracilis* 11.4%, *C. caeruleus* 8.1%, *L. tapeinosoma* 7.0%, caesionids 35.6%, apogonids 14.9%, *P. pinguis* 0.2% and *D. hasselti* 0.2%. A direct quantitative relationship was observed between the live-bait fish catch and tuna catch, the months of good catch of tuna being those of good availability of live-bait fishes.

The present status of live-bait fishery at Minicoy indicates that the demand for the live-bait fish exceeds their availability in the atoll. The environmental deterioration by way of large scale siltation has resulted in the mass mortality of corals, which in turn affected the resident ichthyofauna, many of which are employed as live-baits.

At Minicoy, the investment on fixed capital, operational expenditure and the returns are almost similar to those at Agatti. The average crew of a pole and line boat is twelve. A unique traditional system of collective effort and sharing of the total income is prevalent at Minicoy. There are ten fishing villages in this island and each village head is known as 'Moopan.' The majority of the pole and line boats which are in the name of village Moopan is the collective property of the village. Pole and line fishing is a combined effort of the village since it involves various specialised activities such as fabrication of live-bait fish net, bait box, bait basket, diving for location of live-bait fish, bait fishing, scouting for tuna schools, chumming the shoals and hooking. There is division of labour and each fisherman is specialised in a particular aspect of fishing. Hence their catch sharing system is also very peculiar. One third of the catch is the share of the boat owner. Out of the rest of the catch, two shares go to the captain of the boat, two for the diver for bait fish location and the other crew get one share each. There is a second category of shares for the other collective efforts involved in the fishing. They include shares for the village house, Moopan, repair of boat and engine, cleaning the beach for unloading the catch, fabrication and repair of live-bait fish basket, supply of hooks for fishing, for mosque *etc*. However, if the catch is very poor, shares for the second category of collective efforts are not given. On the contrary, if the catch is very good, even some other shares which are not listed above are also given.

Suheli Par: Suheli Par consists of two uninhabited islands *viz.* Cheriyakara and Valiyakara. The fishing operations are based at Cheriyakara. The pole and line fishing around Suheli Par is practised by the fishermen mainly from Kavaratti and Agatti, who come with the fishing equipments and necessary provisions for camping at Cheriyakara for a period ranging from three weeks to one month at a time. Temporary thatched huts and other necessary arrangements are made by them for camping and for the preparation of *masmin*. Each day's catch is converted to *masmin* and stored.

On an average, twenty pole and line boats operate for about twenty fishing days in a month from Suheli Cheriyakara during the active fishing months *viz.*, November to April. The total annual effort comes to 2,400, yielding about 600 tonnes of tunas with an average catch per boat of 250 kg.

The vast sand flat of the lagoon of Suheli Par is a rich ground for *S. delicatulus* which is the only live-bait fish exploited at present. The recent exploratory live-bait fish survey revealed that the sprat *S. gracilis,* pomacentrids like *C. caeruleus,* apogonids and caesionids are also available for reasonable exploitation *(Appendix)*.

The fixed capital involved in the fishing is same as that of Agatti and Minicoy. The average recurring expenditure for a fishing boat which includes the cost of diesel, engine oil, maintenance charges and food and refreshment of the crew comes to about Rs. 5,000/ and is incurred by the boat owner. The average quantity of *masmin* produced by a boat which camps at Suheli Par during one month is about 1,000 kg. The revenue from this comes to about Rs. 30,000/- at the rate of Rs. 30/- per kg of *masmin*. Half of the revenue is the share of the boat owner and the rest is shared by the crew whose number is usually nine.

It is felt that there is further scope for developing the small-scale pole and line fishery around Suheli Par. For the purpose, there is an urgent need to provide basic requirements in these uninhabited islands. As opined by Varghese (1986), infrastructural facilities including sweet water are not available in this place to attract fishermen from other islands, and the islands are privately owned. Arrangements for the camping of one mechanic with engine spare parts and arrangements for supply of diesel deserve attention. Since about 200 fishermen, on an average, camp at Suheli Cheriyakara during the fishing months arrangements for getting essential provisions and medicines require urgent attention. As stated by Varghese (1986) if Suheli Valiyakara is acquired and made into a common fishing centre with infrastructural facilities and provision of drinking water, it can be converted as a major tuna fishing centre.

Bitra: Bitra, the smallest of the inhabited islands has got the largest lagoon. Fishing around Bitra, Cheriyapaniyam Reef and Baliyapaniyam Reef is practised by fishermen mainly from Bitra, Chetlat, Kiltan and Agatti. The fishermen coming from other islands camp at Bitra in temporary huts for a period ranging from three weeks to one month at a time and the tuna catch is converted to *masmin,* as is practised at Suheli Par.

On an average, 15 pole and line boats operate for about twenty fishing days in a month from Bitra Island during November–April season. The total annual effort comes to 1,800, yielding about 450 tonnes of tunas with an average catch per boat of 250 kg.

The shallow coastal areas and the southeast sand flat of the lagoon harbour a rich resource of *S. delicatulus* which is currently exploited for tuna fishing. The exploratory live-bait resource survey revealed that the vast lagoon of Bitra possesses exploitable resources of pomacentrids like *C. caeruleus,* apogonids like *A. fucata* and *R. gracilis,* caesionids like *C. caerulaureus* and the sprat *S. gracilis (Appendix)*. The above factors indicate that the small-scale pole and line fishery now in vogue in the island can be further expanded. Economics of the fishing is similar to that practised at Suheli Par.

Strategies for further development and management

Fisheries development plans in the developing countries should take account of the infrastructure, technology and human resources in addition to harvesting, processing, marketing, servicing and material supply to enable better exploitation of their fishery resources, to increase the value added to economy and to provide better employment opportunities. In the programme planning for the development of small-scale pole and line tuna fishery in the Lakshadweep, the following strategies appear to be pertinent:

(1) Reliable and timely data and statistics on all aspects of fisheries are needed for planning, implementation and subsequent monitoring of fishery management and development. Departmental capability to collect data and information at sub-regional level in the Lakshadweep should be strengthened.

(2) Of recent, in Maldives, the growth of tourism and other economic sectors has led to a reduction of manpower available, but the introduction of machanisation and subsequent increased catch rates by *masdhonis* have ensured the maintenance of annual catches. According to Varghese (1986), the grave problem faced by the fishery sector is the shortage of manpower, and blocking of manpower in the non-productive sector may be the remedial measure. While presenting the scenario for 2005 A.D. in the Lakshadweep based on some current trend of events, Sagar (1986) opined that tourism would enhance the economy of the people mainly at Agatti and nearby islands, and according to him "these sources of income have helped to fill the gap left by fishing, which has declined greatly. Some pole and line fishing continues, but the fishermen are growing old." A suitable proposal for providing employment and income generation for the local population by introduction of enhanced per capita income plans by IRDP/NREP agencies would seem to make fishing in the small-scale sector more lucrative.

(3) Development and management plans should take into account the need to protect marine habitat around the islands from any form of degradation. The coral colonies which harbour the live-bait fishes are prone to natural senescence. In addition, indiscriminate dredging and blasting of the lagoon habitat may cause altered current patterns, which may result in the siltation in the areas of coral growth, thereby causing the death of coral colonies and the resident live-bait species. Environmental damage should be kept minimum while implementing development programmes for navigation.

(4) Recent, aimed exploratory tuna live-bait resource surveys conducted in the Lakshadweep by scientists attached to the CMFRI establishment at Minicoy and Agatti (November–December, 1986) have proved beyond doubt that vast resources of potential live-bait fish species, both migrants and residents (other than the traditionally used sprat *S. delicatulus)* are available around Agatti, Bangaram, Perumal Par, Suheli Par, Kadamat and Bitra. Results of these surveys, coupled with the economically viable methods of confinement and transportation of hardy live-baits would contribute much in planning the utilisation of live-bait species of these areas, without geopardising economic viability by exhausting their resources.

(5) About 3,000 tonnes of tunas are annually exploited by the small-scale pole and line fishery and the approximate contribution by Agatti, Minicoy, Suheli Par and Bitra are 45%, 20%, 20% and 15% respectively. Of these, at Minicoy, its isolated geographical location and the consequent inability of small pole and line boats from expanding the area of fishing without navigational aids and the scarcity of live-bait fishes often experienced by the fishermen are the main constraints for the further expansion of the fishery. On the contrary, Agatti, Suheli Par and Bitra, due to their proximity to other islands and reefs and also due to the added advantage of getting enough of live-bait fishes, offer further scope for the expansion of the present small-scale pole and line fishery.

(6) The introduction of a new generation of larger pole and line vessels with adequate navigational, chilling and storing facilities for 4–5 days of fishing as recommended by Silas and Pillai (1982) is particularly significant to Minicoy Island due to its isolated geographical location. In this connection, it is worth mentioning that a radio beacon station and a radar transponder beacon (RACON) (9,300 to 9,500 MHZ) are working at Minicoy Light House. These navigational aids can be made use of by the fishermen with the help of a simple direction finder/radar equipment.

(7) The high catch rate of fishing from schools associated with flotsam at Minicoy, as stated earlier indicates that installation of Fish Aggregating Devices (FAD) may be successful in augmenting tuna production. The major impact of FADs, as observed by Silas and Pillai (1982) will be in the small-scale sector such as pole and line fishery as tuna fishery around these structures result in increased catches, reduction in scouting and voyage times from shore which conserve fuel, energy and also it is a safety factor for the operation of small boats. However, the experiments conducted elsewhere indicated that they are very successful at aggregating tunas, but have todate suffered from very short life time. Further research appears to be necessary on this subject.

(8) There is an urgent need for encouraging the fishermen of different islands other than Minicoy for the rational exploitation of the live-bait resources other than *S. delicatulus*. As already mentioned, *S. delicatulus* is the only live-bait species currently exploited for

tuna fishing in the islands other than Minicoy. This being a shallow water species which exhibits good chumming qualities is easy to be fished in desired numbers using encircling type of nets. However, the major constraint in the utilisation of this species is the large scale mortality at the time of capture, storing in livebait tanks and transportation, due to osmoregulatory stress. Moreover, since the fishery is dependent on the availability of this single species, scarcity of the same often causes abrupt suspension of fishing activities even during peak fishing months.

Steps should therefore be taken to encourage fishermen for exploiting the baitfishes belonging to Pomacentridae, Apogonidae and Caesionidae which are associated with coral colonies in the deeper parts of the lagoon by means of lift nets. Species belonging to the above groups exhibit good chumming qualities. The exploitation of these groups will, not only augment the production of tunas but also dispel the threat of over-exploitation and the consequent depletion of the stock of *S. delicatulus*.

(9) Another aspect which deserves serious attention is the absence of significant pole and line fishing activity at certain islands such as Kadamat and Kalpeni where exploitable tuna live-bait resources belonging to sprats, apogonids, pomacentrids and caesionids have been located. Initiation and expansion of pole and line fishing in these islands and encouraging fishermen for utilising the unexploited resources of live-bait fishes are suitable propositions for the policy planners involved in the development of tuna fishing industry in Lakshadweep. As referred to earlier (2), this can be achieved by providing means to make tuna fishing lucrative by developmental agencies.

The non-availability of the required number of poles used in the fishing is a problem for the fishermen, since they have to be obtained from mainland. A scheme for making them locally available through Fisheries Development Agency in the Island, as is done in the case of diesel, will be an incentive for the small-scale fishermen.

(10) In Lakshadweep, the main method of disposal of catch is by converting it to *masmin*. At Agatti, Suheli Par and Bitra, the catch after removing a fraction for domestic consumption is converted to *masmin*. Approximately 500 tonnes of *masmin* are produced annually from Lakshadweep in recent years. The price of *masmin* varies from Rs. 30 to 40 per kg. At present there is no organised marketing system for *masmin* in Lakshadweep. The development of an organised marketing system will be beneficial to the tuna fishermen since it can solve to some extent the present problems of getting proper market and sudden price fall of the product. In this context, the recent experience in the Maldives in the tuna industry is an example while planning development of production of tunas in the small-scale sector in the Lakshadweep. The loss of Sri Lankan market for export of *'Maldive fish'* led to a shift in exports of frozen and canned tunas (Anderson, 1986). At Minicoy, a portion of the catch (average 70 tonnes annually) is canned by the Government Canning Factory, and a scheme for establishing canning factory at Agatti has recently been proposed. However, in view of the economical returns, steady market for *masmin* inside the country and outside should be explored and developed.

(11) Disposal of wastes is another aspect deserving immediate attention. At present, the head, bones, fins *etc*. of the fish are discarded on the beach of the islands, which get decayed and act as breeding sites of house flies and cause health hazards during the fishing season. An effective small-scale wastes utilisation method by converting them to fish-meal may be advisable since the product can be used as an excellent manure for coconut plantations in the islands. Alternatively, the possibility of converting the wastes from tunas as ensilage should be explored.

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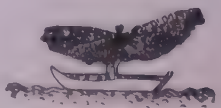
APPENDIX

List of major species contributing to the live-bait resources of Lakshadweep

Family	Species	Local Name
Dussumieridae	*Spratelloides delicatulus*	Hondeli*; Manjachala*
	S. gracilis	Rehi*; Churaichala+
Apogonidae	*Archamia fucata*	Rybodi*; Poothan+
	Apogon sangiensis	Dombodi*; Poothan+
	A. leptacanthus	Dikkuribodi*; Poothan +
	Rhabdamia gracilis	Rehibodi*; Poothan+
	R. cypselurus	Digubodi*; Poothan+
	Ostorhynchus apogonide	Bondu*
	O. quadrifasciatus	Rumkuribodi*; Poothan+
Caesionidae	*Caesio caerulaureus*	Hudenmugurang*
	C. xanthonotus	Donkevumas*
	Gymnocaesio argenteus	Dandimugurang* Chooraichala +
	G. gymnopterus	Geretha*
	Pterocaesio pisang	Rymugurang*
	P. tile	Rymugurang*
	P. Chrysosona	Kekkurimugurang*
Pomacentridae	*Chromis caeruleus*	Nilamahi*; Pachakotai+
	C. nigrurus	Idugidari*
	Pomacentrus pavo	Huibui*
	Lepidozygus tapeinosoma	Bureki*; Majahibureki+
Atherinidae	*Pranesus pinguis*	Fitham*; Tholiyan +

* = at Minicoy; + = at northern islands



TIDAL WAVES CAUSE DAMAGES TO COASTAL VILLAGES IN KERALA*

The nature very often takes people by surprise and causes hardships by way of natural calamities. The incidence of such calamities are relatively more in the coastal areas. Every change in nature is reflected some way or the other along the sandy sea shores. One such instance occurred along the Kerala coast between Aarattupuzha (Alleppey District) in the south and Nattika (Trichur District) in the north for a distance of about 150 km. In the midnight of 10th October, 1987 when the coastal dwellers were peacefully sleeping after a day's hectic fishing activities, giant tidal waves started mounting in the sea and struck hard against the shore and rolled over the sandy beach. The water spilled over the sand mounds as if from a bowl filled to the brim. The sea water freely entered the thatched huts on the sea shore and filled them with knee deep or more water. The fishermen ran helter-skelter for their lives and properties.

On receiving the news a team of scientists from the Central Marine Fisheries Research Institute, Cochin visited the southern area between Thottappally & Aarattupuzha for an on-the-spot assessment of the situation. It was found that the tidal waves had caused considerable damages to houses and crops between Pallana (south of Thottappally Spillway) and Aarattupuzha (north of Kayamkulam bar mouth) especially where the sea walls were absent. It is a fact that in this area, as is the case with major portion along the Kerala coast, the land behind the beach is much lower than the mean sea level and therefore the tidal waters once crossed over the beach could find a convenient way into the coastal road and inundate agricultural lands thereby causing considerable destruction to the crops and filling fresh water wells in the villages with saline water.

At least 10 houses have been damaged in this area mainly due to heavy deposition of sand. In some houses it was found that at least a metre of sand had got deposited (Figs. 1 and 2). The sand found entry into these thatched houses through the side protections which are also made of coconut leaves. The team of scientists could witness people removing sand from inside the houses.

Over a stretch of 17 km, the coastal road was found cut across at three places namely Pallana, Mangalam and Aarattupuzha due to the tidal flow. Deep trenches were formed across the road which disrupted the traffic Figs. 3 and 4. However, local people made alternate means to make good the way.

Several low lying areas were inundated with knee deep or more sea water especially at Mangalam. Fortunately these are areas where coconut trees are grown and hence no destruction to such crop has occurred due to saline water. In order to find out whether any alarming situation has been developed on account of inundation, water samples were collected for the analysis of environmental parameters including primary productivity and bacteriology. Simultaneous to this, samples were collected from the sea side also for a comparative idea. The parameters analysed and the results obtained are given in Table 1.

Table 1. *Details of the environmental and biological parameters analysed for the inundated and surf waters*

	Diss. O_2 (ml/l)	Salinity (‰)	Primary productivity (mgC/m^3/day)	Microbial parameters		
				Yeast (No/ml)	*E. coli* (No/ml)	Heterotrophs (No/ml)
Inundadated water	3.52	23.6	500	22	2	78.4x10^5
Surf water	5.05	33.3	114	296	64	96.8x10^6

The results showed that the salinity of the inundated water was less by 10‰ than the sea water and this was due to its dilution with rain water. There was a marked difference in the rate of dissolved oxygen, being less in the stagnant inundated water but this was in no way less than the minimum required level for existence of life. The primary productivity value showed high rate of production in the over flowed water. As far as the bacterial flora was concerned the yeast and heterotrophs were seen in greater numbers in the inundated water

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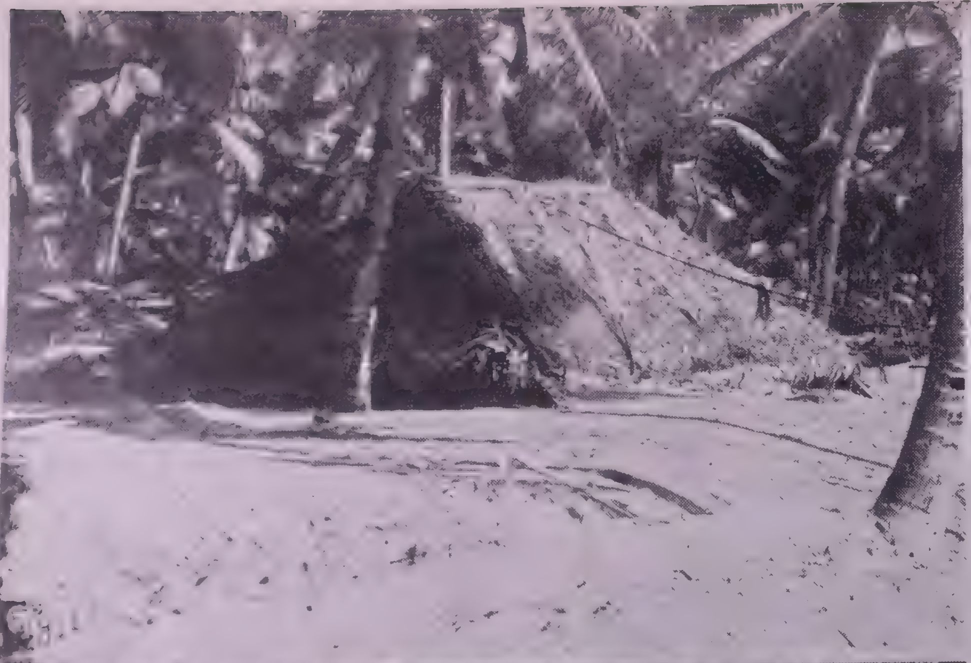
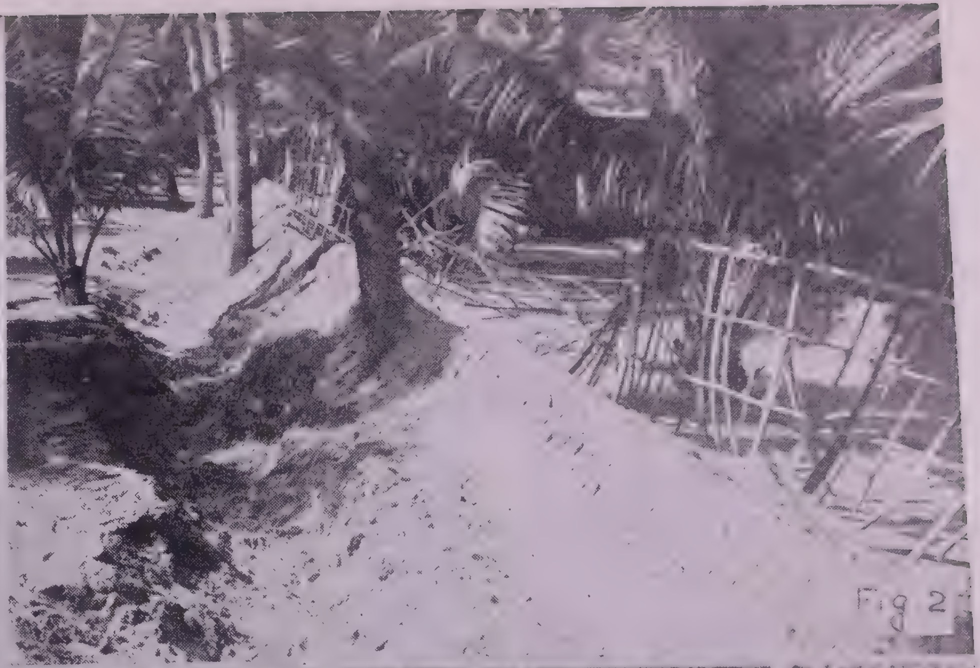
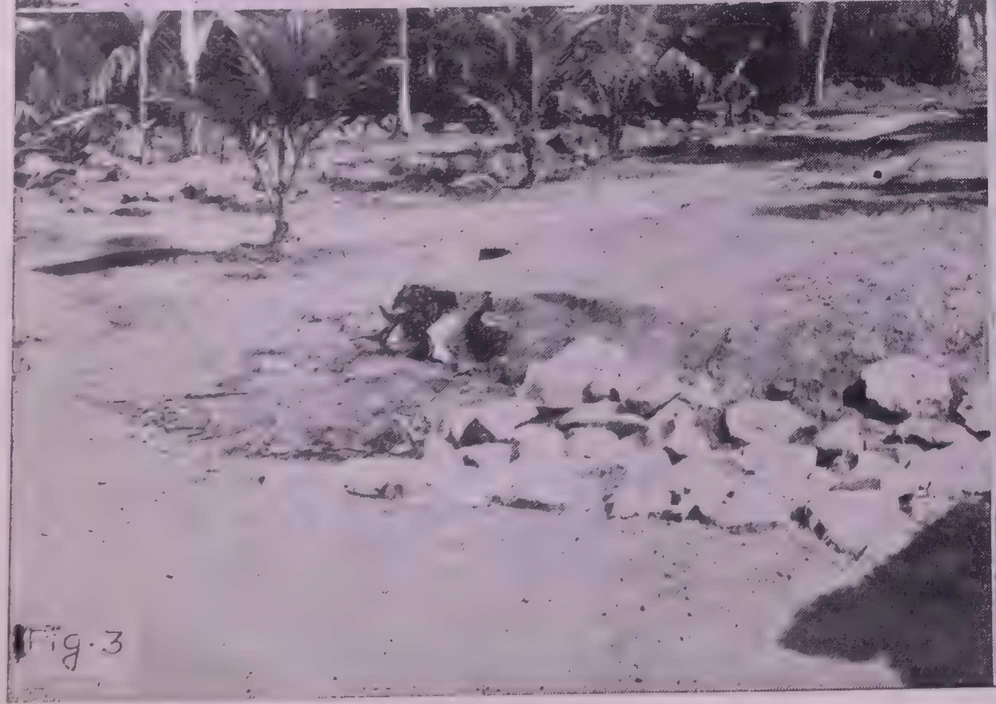
*Prepared by K.J. Mathew, N.Surendranatha Kurup, V.Chandrika, G. Balakrishnan and K. Gopalakrishna Pillai, CMFRI, Cochin.







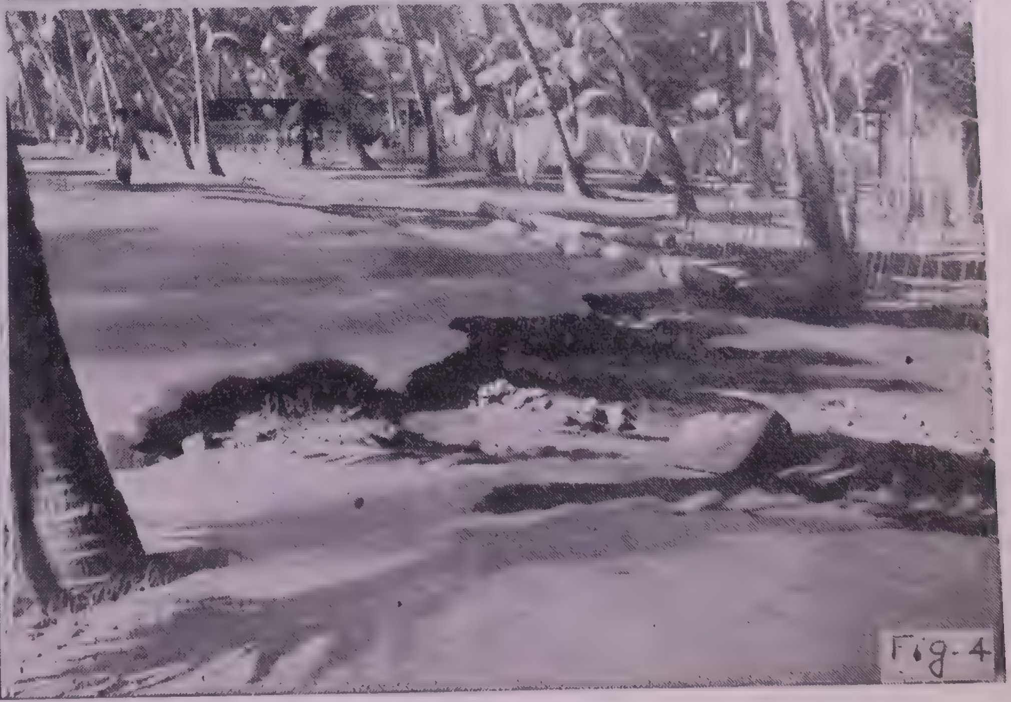


Fig. 1. The tidal waves have deposited sand upto the roof level of this hut (1987). Fig. 2. The fishermen have made sand ridges as a precaution against further erosion. Also please note the damaged fencing (1987). Fig. 3. A deep and wide cut across the road at Mangalam filled by people with granite stones for restoring traffic (1987). Fig. 4. Another view of the damaged road at Aarattupuzha (1987).

and *E. coli* though present in smaller numbers was relatively more. The large number of *E. coli* in sea water may be due to faecal matters found here and there in sea coast. The results obtained clearly indicated that the stagnant water was quite healthy and may not cause any health hazard to the local people.

The tidal waves as detailed above have swept the land at other places also namely Narakkal and nearby areas, and between Kodungalloor and Nattika on the same day and at almost the same time. According to reports, 2,000 houses have been affected of which 40 were totally destroyed and 100 partly in the Kodungalloor and Nattika taluks. The most affected area was between Kulimuttom and Kaippamangalam. The waves which rose to a height of 3 m caused havoc in a 10 km stretch of coast line in this area. In some places water reached upto the National High Way which is about 4 km away from the beach. The low lying areas were inundated to such an extent that the evacuated people had to be taken to safe place in canoes.

Four hundred families who had to run away from their houses were given temporary shelter in the local schools at Kaippamangalam, Perinjanam and Aarattukadavu. There have been considerable damages to fishing nets and canoes. At Perinjanam six canoes have been swept away by the tidal waters. Several coconut trees and other trees have been uprooted in this area. Vast areas were inundated with sea water.

There was no apparent reason for such a natural calamity along the coast except for the fact that it was a full moon day on the 7th of October. The sky was rather clear and there was no wind of any mentionable velocity.

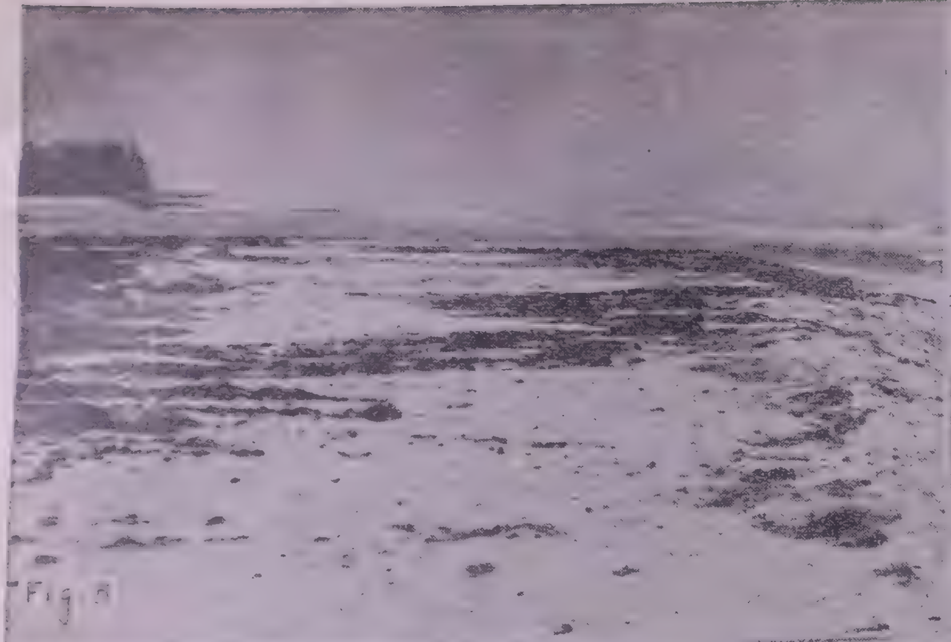
The heights of the highest high tides predicted for Cochin in different months in 1987 are given in Table 2 for the sake of understanding whether there could be any unusual high tides indicated for October which could rise above the usual heights. However, it is found that in October the highest high tide measured 0.99 only which was to occur at 0228 hrs on 25th and therefore no positive correlation could be made between the conventional tides and the one which occurred in the night of 11th October. Therefore, it may be concluded that the tidal waves would have been the result of some changes in the climatic or oceanic conditions in the open sea.

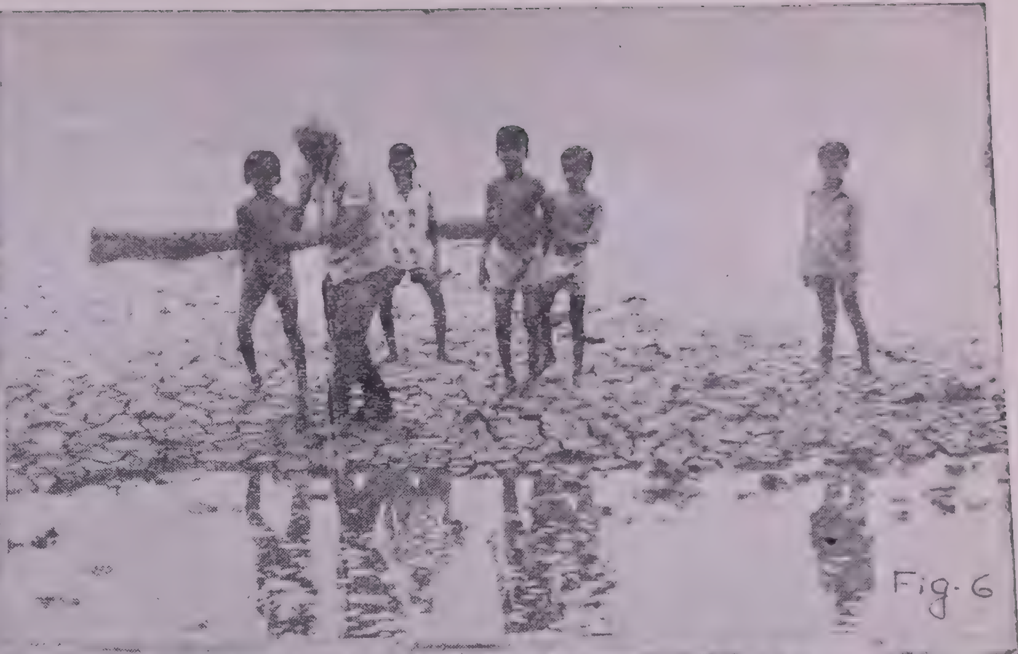
Table 2. *The height of spring tides and their details predicted for Cochin during* 1987

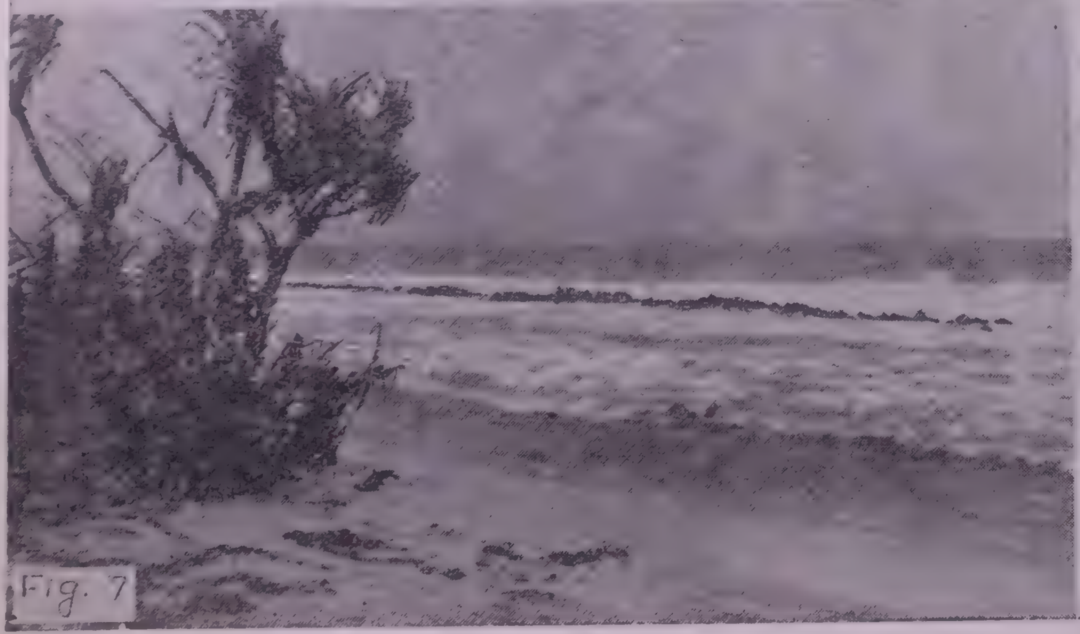
Month	Height of the spring tide (m)	Date	Time (hrs)
January	1.19	2	0239
February	1.17	1	0246
March	1.08	1	0137
April	1.03	29	1411
May	1.05	15	1419
June	1.03	12, 13, 14	1343,1424, 1505
July	1.00	13	1443
August	0.94	10, 11, 12	1407,1407, 1431
September	0.89	9	1309
October	0.99	25	0228
November	1.09	23, 24	0224,0303
December	1.16	22, 23, 24	0218,0252, 0328

There have been earlier cases of such sudden changes in the sea. One such instance occurred in the midnight of 29th August, 1980 when tidal waves rose over the beach between Alleppey and Quilon in the same manner as has happened at present. The waves swallowed considerable stretches of sandy beach. The greatest havoc was caused at the mud bank region in the Ambalapuzha–Thottappally area where tens of coconut trees were uprooted and seven houses were washed off leaving no signs of their existence. Two fish storage sheds built in bricks and cement were also completely destroyed at Ambalapuzha and heavy movement of sand occurred. Inundation of low lying areas also occurred.

The mud of the mud bank was completely dissipated over night and rough sea prevailed there. The dissipation of the mud bank aided by the tidal waves in 1980 was quite sudden and phenomenal unlike in the normal way which is a slow and gradual process. Part of the mud of mud bank was washed ashore along with fishes, shells and polychaete colonies and the rest was aggregated in the sea to form a platform of mud of about 3 km long and 0.5 km wide which could be seen above water level during the low tide. However, within 12 hours the aggregated mud was beaten away and thus the mud bank was completely dissipated causing rough sea in the area.







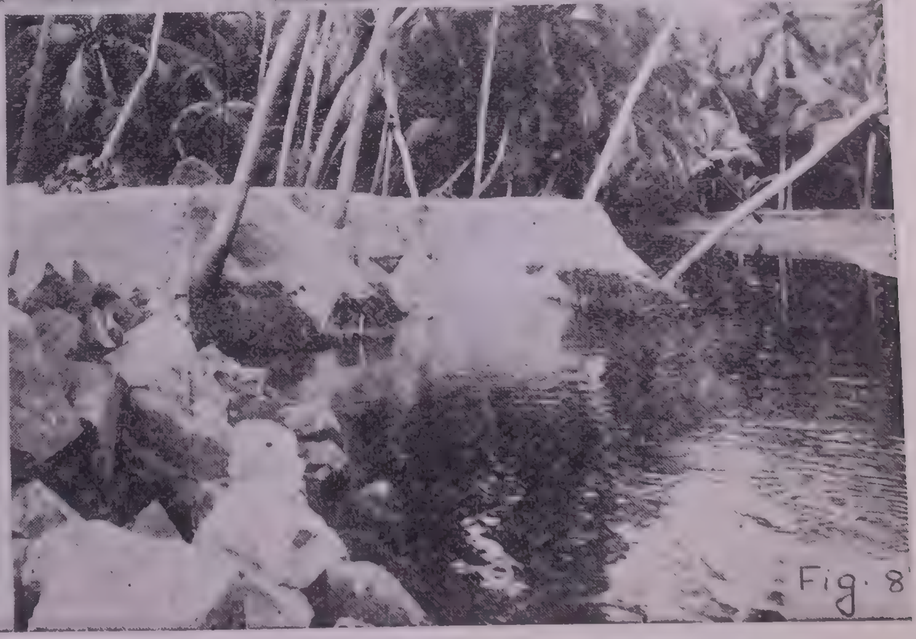


Fig. 5. Streaks of mud seen on the beach at Purakkad mud bank area. Major part of the mud is covered by sand (1980). Fig. 6. The mud thrown on to the beach at Purakkad after being baked in the sun (1980). Fig. 7. The sea has come far interier into the land. In the water is seen the sea wall which was no barrier to the roaring tidal waves. A scene at Ambalapuzha (1980). Fig. 8. Vast areas of unprotected beaches were eroded along the Alleppey–Quilon coast and the sea had come to the coconut plantations. A scene at Purakkad (1980).

In the present case since normality returned after about 24 hours when the team visited the tidal wave hit areas it could see normal life prevailing everywhere including fishing operations except in the case of damaged houses.

Eventhough of a short duration, such tidal waves can cause considerable damages and miseries to the coastal populace. It is extremely difficult to predict such happenings. One thing noticed was that damages were minimum wherever sea walls are present. Therefore the practical solution to such sudden natural calamities is to protect the coast line by constructing sea wall wherever the same is not present. These would save the land and other properties even during other times especially the southwest monsoon when heavy coastal erosion takes place as a regular phenomenon.

Thanks are due to Shri V. K. Balachandran, Technical Assistant for helping in the analysis of the productivity samples.

AN UNUSUAL CATCH OF THREAD-FIN BREAMS BY TRAWL NET AT VERAVAL*

Introduction

The thread-fin breams, locally known as 'Lal machala' constitute 0.6 to 12.39% of the total catch during the different months of their landing at Veraval. After the monsoon season, the trawl net fishing starts by the end of September or beginning of October. But in this year (1986), the operations commenced earlier and fishing was carried out from the middle of September onwards. During the mid September to October beginning, the trawlers brought heavy catch (estimated to be about 2,400 tonnes) of *Nemipterus* spp. and the observations recorded during that period is being reported here.

Fishing operations and fishery

The trawlers set out for fishing in the early morning and return in the afternoon. Each trawl unit normally undertake 2 to 3 hauls per trip, each haul lasting for 2 to 3 hours at depths varying between 30 and 40 metres.

From 16-9-1986 onwards the trawlers brought huge catches of *Nemipterus* spp. (Fig. 1). The catches which were abundant in the initial period started declining subsequently. The date-wise catch and other particulars are given in Table 1.

Table 1. *Date-wise estimated number of units, catch, C.P.U.E. percentage and species composition of* Nemipterus *sp.*

Date	No. of units	Estimated catch (kg)	C.P.U.E. (kg)	% *Nemipterus* in total landing	Species composition (kg)	
					N. mesoprion	*N. japonicus*
19-9-'86	105	1,80,900	1,723	88.11	1,75,016	5,884
22-9-'86	73	75,926	1,040	61.54	72,521	3,405
24-9-'86	145	56,926	389	29.72	54,513	1,823
26-9-'86	103	29,631	288	29.21	28,015	1,616

It could be seen from Table 1 that the percentage of *Nemipterus* spp. in the total landing was very high (88.11%) which decreased later (29.21%). In the catches two species *viz. N. mesoprion* and *N. japonicus* were recorded. The *N. mesoprion* dominated in the catch (94.55%) The *Nemipterus* in general are known to have their own specific (defined) depth ranges (Eggleston, *J. mar. biol. Ass. India*, **11**: 357-364, 1973).

The total estimated landing of *Nemipterus* spp. during the observation period of September was 2,399.621 tonnes. During this period, each boat was estimated to bring 804.70 kg of *Nemipterus* spp. which constituted 55.14% of the landings at Veraval.

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*Prepared by S. G. Raje and A. P. Lipton, Veraval Research Centre of CMFRI, Veraval.

Fig. 1. Trawl catch of *Nemipterus* sp. at Veraval.

Biological observations

Sex ratio and maturity

The sex ratio of *N. mesoprion* was 1:1 whereas that of *N. japonicus* was 1:3. The percentage of male and female, their size range and maturity are given in Table 2.

Table 2. *The size range (in paranthesis), sex ratio and relative abundance (%) among resting, developing and gravid* Nempterus *spp. landed at Veraval*

Name of species	Male	Female	Resting	Developing	Gravid
N. mesoprion	51.43 (113–170 mm)	48.57 (113–160 mm)	11.76	17.65	70.59
N. japonicus	24.14 (149–172 mm)	75.86 (142–164 mm)	—	18.18	81.82

It could be noted from Table 2 that less number of males was encountered among *N. japonicus,* which could be attributed to their migratory behaviour. Eggleston (1973) reported that only sexually mature large males migrate to the deeper zones. It has been also stated by Eggleston (1973) that in the shallower part, smaller and sexually mature fish aggregate during the spawning season.

Feeding condition and food

The stomach content analysis of both *N. mesoprion* and *N. japonicus* indicated that stomachs of more than 60.0% and 80.0% in both the species respectively were empty (Table 3).

Table 3. *Feeding conditions of* N. mesoproin *and* N. joponicus

Species	Percentage					
	Gorged	Full	1/2	1/4	Trace	Empty
N. mesoprion	2.86	2.86	17.14	8.57	5.71	62.86
N. japonicus	—	3.45	—	6.90	6.90	82.75

The occurrence of more specimens with empty stomachs might be due to their feeding behaviour. Eggleston (1973) pointed out that *Nemipterus* sp. are day light feeders. As the trawling commenced in the early morning it was likely that majority of them was caught before feeding.

The only food item observed in the stomachs of both species of *Nemipterus* was *Acetes indicus* which was observed as freshly injected or partially digested conditions.

Size range

Size range of *N. mesoprion* was 90 to 200 mm (TL) with modal size of 130 mm. In *N. japoncius* the size ranged between 140 and 200 mm with modal size of 160 mm. It is presumed that the shoal belong to the first year group.

Fig. 2. *Nemipterus* sp. being transported through auto carriers in bulk quantities at Veraval.

Economics

Due to the heavy landing and lack of demand in the market and as the fish landed were of smaller sizes they were sold at the landing centre itself at Rs 0.70 per kg (Fig. 2). The total value realised during the second half of September at Veraval has been estimated to be Rs. 17.00 lakhs and the value per boat per day to be Rs. 563.29. The fishermen could recover the operational expenditure including the expenditure on food for crew members from the sale proceeds of *Nemipterus* spp. itself.

Remarks

The thread-fin breams form an important demersal fishery resource at Veraval. Their fishery is supported by two species *viz*., *N. japonicus* and *N. mesoprion*. Although *N. japonicus* was recorded throughout the year, the *N. mesoprion* formed a seasonal fishery only.

Considering the bumper catch of *Nemipterus* spp. it becomes imperative to suggest steps to utilize the catch in diversified ways. It has been indicated that bacteriological peptone prepared from *Nemipterus* was of high quality. Also it is essential to observe some regulatory measures as more gravid specimens were observed in the catches.

Acknowledgements

Thanks are due to Shri B. P. Thumber, Shri H. K. Dhokia and Shri M. S. Zala for providing technical assistance during the observations.

INTRODUCTION OF MECHANISED-CUM-SAIL CRAFTS AT KAKINADA*

Kakinada is one of the important mechanised fish landing centres of Andhra Pradesh. Fishery resources from inshore waters off Kakinada have been traditionally exploited by indigenous crafts, *ie*. 'Navas' (plank–built boats). At present these 'Navas' cover only the nearby fishing grounds. Recently mechanisation of the fishing vessels is being taking place along this coast and this has resulted in increase of catches and thereby better income for the fishermen. These motorised beach-landing crafts conduct fishing at distant fishing grounds at depths ranging from 70 to 90 metres using synthetic drift gill nets of larger meshes. These fishing crafts are built by new construction material – the fibre glass. These beach-landing crafts are without keel and therefore flat-bottomed. They have long fore-deck and short stern deck. They are usually painted red and this colour helps their identification in the sea. The boats are fitted with in-board two cylinder diesel engines of 10 H.P. Generally the weight of the engine is 115 to 120 kg. The air cooled or water cooled engine is fitted at stern of these boats. The length of the boat is 8.45 metres, beam 2.27 metres, depth 0.828 metres and draft 0.45 metres and has a gross tonnage of 2.5 tonnes. There is no gear system to reverse the boat. Fuel tank is fitted at one corner very near to the engine. A mast and sail are provided in this craft as reserve, and are used whenever the engine fails.

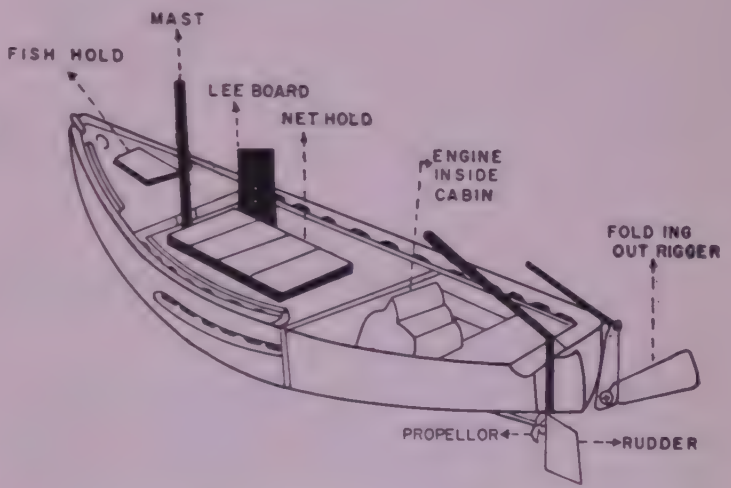

Fig. 1. A mechanised-cum-sail craft operating at Kakinada.

The craft is very economical as it requires very less repairs and maintenance. These crafts are manned by four persons. It does not require any jetty or wharf facilities to land. There is a fish hold to keep the fish caught and a net hold to keep the nets at the longer fore-deck. There are some arrangements of folding out-rigger (balancing) board and a straight lee board to manage the large sail during sailing. Durability of hull is longer when compared to the materials of other boats. The local boat building yard of Andhra Pradesh Fisheries Corporation at Kakinada is constructing these beach-landing crafts. They issue these boats to marine fishermen under Small Farmers Development Agency (S.F.D.A) on 50 percent subsidy scheme.

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*Prepared by C V. Seshagiri Rao, Kakinada Research Centre of CMFRI, Kakinada.

These beach-landing crafts leave the landing centre daily during afternoon and return the next day morning. Fuel consumption of the engine is at the rate of 1.5 litres per hour. Usually the running time of the engine is 6-8 hours for to and fro fishing trips. The average speed is 8 to 10 kilometres per hour.

Some of these motorised beach-landing crafts are regularly operating at Subbammapeta, Godarigunta, Kondalupeta, Kotha, Kakinada, Parralopeta, Dummulapeta, Yetimoga, Pagadalupeta and Uppulanka. In the lean season some of these crafts are taken to other places namely, Bhairavipalem, Rameswaram, Vadalarevu of East and West Godavari districts and Machilipatnam area and Puri, Paradeep and other places in Orissa State.

Synthetic drift gill net: These motorised beach-landing crafts conduct night fishing using synthetic drift gill nets with larger mesh sizes. The total length of these drift gill nets varies from 1000 - 1600 m and 9 m in height. Generally 45–75 webbed pieces are plied together. Round cement sinkers and cylindrical synthetic floats are used to keep the net vertical in water. The entire net is fabricated from No. 5 or 6 dark blue multifilament twisted twine.

These motorised crafts operating synthetic drift gill nets land mainly large sized pelagic fishes such as seer fishes, tunas, pomfrets, cat fishes, elasmobranchs, carangids, thread fins and other fishes in order of their abundance.

Sometimes the fishermen operate these gill nets as bottom set gill nets using more number of cement sinkers to catch demersal fishes.

At the time when the motorised beach-landing craft was introduced at Kakinada during June, 1986, its cost was about Rs. 1,23,600. The price details are as follows:

Cost of boat fitted with engine and its accessories	Rs.	1,22,000
Cost of canvas sail	Rs.	1,000
Cost of iron anchor	Rs.	150
Cost of 4 small oars	Rs.	100
Cost of miscellaneous items	Rs.	350
Total	Rs.	1,23,600

The drift gill net fishery with motorised crafts has proved highly profitable due to the increase in quantity and quality of fishes caught. The increased speed and accessibility to the distant fishing grounds are other factors responsible for this higher income.

NEWFANGLED TACKLES FOR CEPHALOPODS*

Eversince cuttlefishes and squids entered the export market, priority for their fishing, especially for the former whose value had been leaping ahead in recent times, is next to that of prawns. The cuttlefish *Sepia pharaonis,* constitutes an important seasonal fishery in the southern part of the west coast of India (Kanyakumari District in Tamil Nadu and Trivandrum District in Kerala) during the September–February period, while the squid fishery of this area, dominated by *Loligo duvaucelli,* is also seasonal almost coinciding with the same period. Though cuttlefishes here form a bycatch in gears like boat seine and shore seine, the major landings come from a few simple indigenous varieties of gears of either local innovation or adaptation from established gear elsewhere. The major squid catches of this area are from boat seine; yet operation of miniature anchor hooks also contributes substantially to its fishery.

What follows is a brief description of some of these less-known varieties of gears. These have been designed

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*Prepared by Jacob Jerold Joel, Vizhinjam Research Centre of CMFRI, Vizhinjam and J. P. Ebenezer, Kanyakumari Field Centre of CMFRI, Kanyakumari.

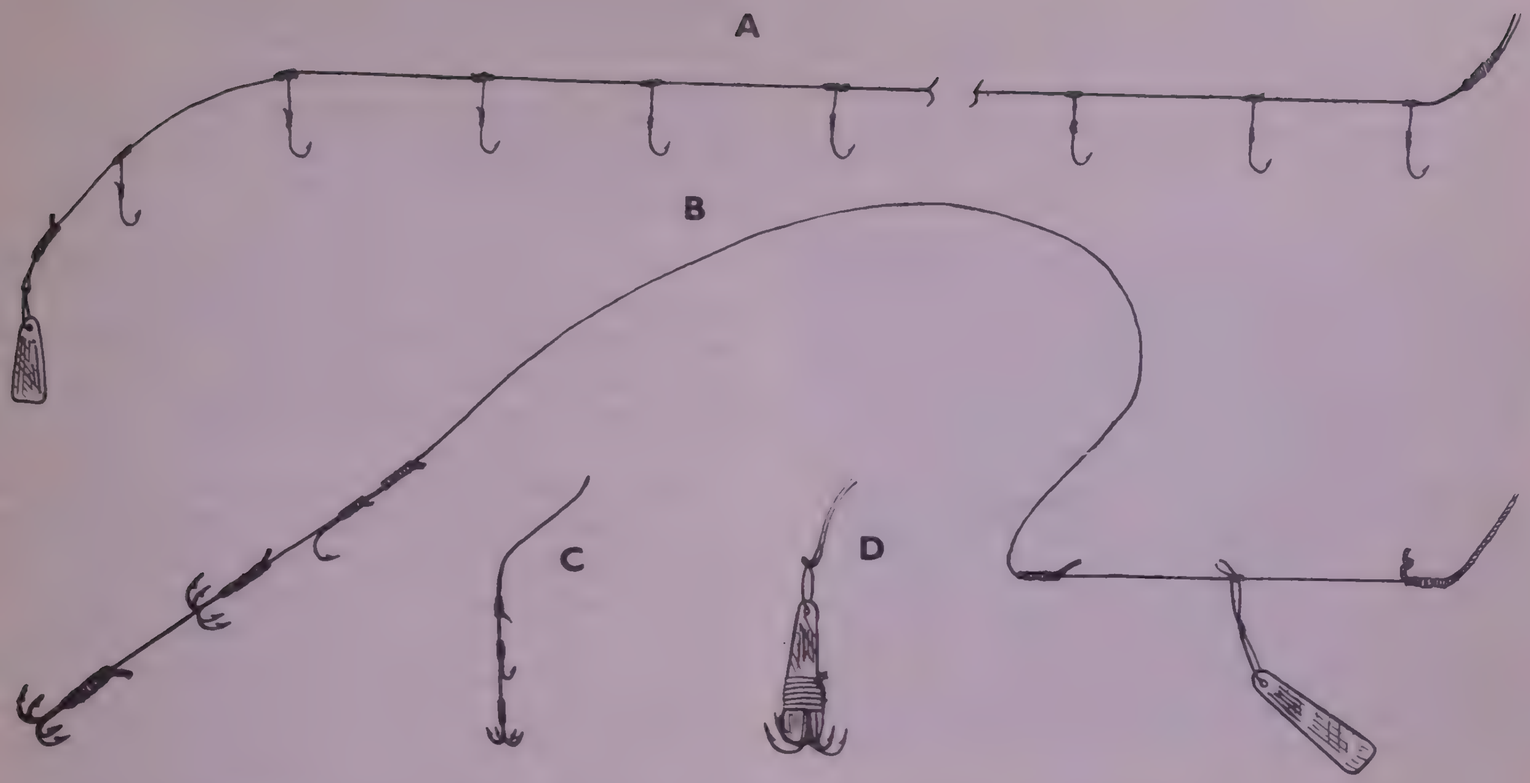

Fig. 1. (A) *'Vidukayiru'* for cuttlefish, (B) *'Nangoora choonda'* for cuttlefish, (C) *'Nangoora choonda'* for squid and (D) *'Disco nangoora choonda'* for cuttlefish.

making use of the line-sinker-hook-bait combination and the fishing technique is hand-jigging, with the species getting hooked or getting attached strongly to the bait till it is hauled up to the surface.

'Vidukayiru' for cuttlefish: This gear is similar to 'Achil' described by Lazarus *(Indian J. Fish.,* 31: 368-370, 1984) but with minor variations to suit cuttlefish collection. Here, the main line, a nylon thread of gauge No. 60 and a length of 5 m or more, has a sinker weighing about 150 g attached at its far end. Short branch-lines, each having a hook (size No. 10 or 9) at its end are rigged to the main line at definite intervals. The length and the space between the branch-lines are so adjusted that no two adjacent branch-lines tangle with each other. Thus, if the length of the branch-line is 15 cm, the space between two adjacent branch-lines has to be a minimum of 30 cm or a little more. The other end of the main line is connected to a sufficiently long hand rope. Similarly, when many crafts are concentrated in a small area, the main line is often restricted to less than 5 m to avoid intertwining of many units. Lengthy and thicker main line (nylon thread No. 100) with more hooks (sometimes upto 100) and lengthier branch-lines are used when fishing by a crew is confined to a limited area. A heavier sinker is used when the impact of the ocean currents is high.

The bait used is the meat of crab or fish, the arms of cuttlefish *etc.*, depending on their availability, or synthetic fibres of different colours. The fishing operation generally is at 30 to 50 m depth from a catamaran with one or two men, or from a plank-built boat with outboard-motor and a crew of four or five. All the crew members operate the gear, sometimes each more than one unit. The operator holding the hand rope, lets the gear into the water till the sinker touches the sea bed and jigs it occasionally. When the cuttlefishes cling to the bait, the pull is felt by the operating fisherman dextrous at it and he slowly pulls the hand rope upwards. As the catch nears the surface, it is collected using a scoop net. This gear, according to the fishermen, is used to catch cuttlefishes that concentrate near the bottom during breeding season.

'Nangoora choonda' for cuttlefish: This is a simplified form of anchor hook, as the meaning of the vernacular term indicates. The design and operation of this gear has been elaborately dealt with by Prabhakaran Nair *(CMFRI Bull.,* 37: 152-156, 1986). Two thin iron rods (usually umbrella or cycle spokes) of about 30 cm length, a sinker weighing about 150 g, a few metres of No. 60 nylon thread, eight to ten hooks of the size No. 10 or 9, a hook in size No. 8 or 7, and 30 to 50 m long

nylon rope are the essential parts of this gear. At the tip of one of the iron rods, a circle of hooks is formed by tying 4 or 5 hooks. A similar circle of hooks is made a few centimetres above the first circle, and a few centimetres further above this, a hook of the size No. 8 or 7. The free end of this rod is then connected to a 1.5–2 m long nylon thread, the other end of which is tied to one end of the other iron rod. At the centre of the second rod, an iron weight is hung on a short-nylon thread. The opposite end of this rod is connected to a nylon hand rope long enough to operate at the required depths.

Though artificial bait (synthetic fibres of many colours), meat of fish and arms of squid and cuttlefish are used, living crab is preferred in some areas. The bait is fixed on the single hook above the two tiers of hooks. In the case of crab as bait, after removing the chelate legs, the crab is tied to or hooked in the barb. The movements of the legs of the live crab are supposed to attract the cuttlefish more. When the gear is lowered at the fishing ground, the cuttlefish engulfs the bait with its arms and, feeling the additional weight in the gear, the operator, moving the gear as to give a few jerks at the hooks, pulls up the rope. The jerk causes the cuttlefish to be ripped by the upper tier of hooks. Any escaping from the upper hooks, has the chance of being caught in the lower. The catch on reaching the surface is collected by a scoop net or picked out by hand. During an operation normally only one (very rarely more than one) cuttlefish is caught by one unit.

Commonly seen modifications of this gear are: (a) Only a single circle of hooks at the tip of the rod with a hook attached a few centimetres above. (b) A single hook of size No. 7 or 6 alone in the place of anchor hook, the bait being either tied to the shank or pierced in the crook of the hook. Here, instead of getting hooked, the victim holds on to the bait and is pulled to the surface and collected by a scoop net. (c) A nylon line with not more than 10 branch-lines, each having one hook of size No. 10 or 9, instead of the rod with circle of hooks. Here also the exploitation is based on the victim's tendency to grip at the bait.

'Nangoora choonda' for squid: The squid-jigging practiced in this area is similar to Vietnam type. The gear is a miniature form of anchor hooks described above for cuttlefishes, but with minor differences. Here, a thin 9 cm long iron rod has 4 hooks of size No. 14 attached at the distal end to form a circle. A hook of the same or slightly larger size is tied a few centimetres above the circle. The other end of the rod is directly connected to a monofilament (No. 60) nylon hand line. The preferred bait is meat or arms of squid itself, but other items like meat of fish or crab, or synthetic bristles are also used. The bait is tied to or pierced into the hook provided for this purpose above the circle of hooks. A man sometimes operates 2 to 4 units at a time, holding the hand lines by the toes also. The ripped squid is pulled to surface and collected into the craft. According to the fishermen, night operation is very yielding during peak season.

'Disco nangoora choonda' for cuttlefish: This gear is made of a conical iron or lead weight of 150 to 250 g and a few hooks of the size No. 10 or 9. By fastening 4 or 5 hooks around the broad end of the weight, a circle of hooks is formed. An eye provided at the tapering end of the cone facilitates rigging through it of a nylon thread of variable thickness (normally No. 100) and required length. The lure is a nylex cloth-bit, preferably golden coloured, which envelops the cone just above the hooks. The method of fishing is jigging and ripping as in 'Nangoora choonda' for cuttlefish described above.

RECOVERY OF A RINGED 'DUSKY SHARK' *CARCHARHINUS OBSCURUS**

A 'Dusky shark' belonging to the genus *Carcharhinus* was landed on 28–3-1987 at Veraval with a ring pierced through the first dorsal fin and the right pectoral fin around the girth of body (Figs. 1 and 2). The shark was caught by gill net (28 mm mesh), 65 km southeast of Veraval at a depth of about 80 m. The morphometric measurements (in cm) of the shark are as follows:

Morphometric measurements (cm) of Carcharhinus obscurus

1.	Total length	185
2.	Fork length	147
3.	Pre caudal length	119
4.	Pre second dorsal length	120
5.	Pre first dorsal length	53
6.	Diameter of eye	2.7
7.	Length of pectoral	36.9
8.	Dorsal caudal margin	52
9.	Height of first dorsal	25
10.	Height of second dorsal	7.2
11.	Height of pelvic	4.7
12.	Height of anal	7.7
13.	Height of trunk	22
14.	Height of caudal peduncle	7.0
15.	Pre oral length	11.0
16.	Width of mouth	17.3
17.	Inter–narial space	10.4
18.	Length of right clasper	23.2
19.	Length of left clasper	20.5
20.	Inter orbital space	18.6

Dental formula

i. Upper jaw (4 rows)	
a. Right upper	14 (I row)
b. Left upper	14 (I row)
ii. Lower jaw (4 rows)	
a. Right lower	12 (I row)
b. Left lower	12 (I row)

The gut was almost empty but with traces of bones of ribbon fish.

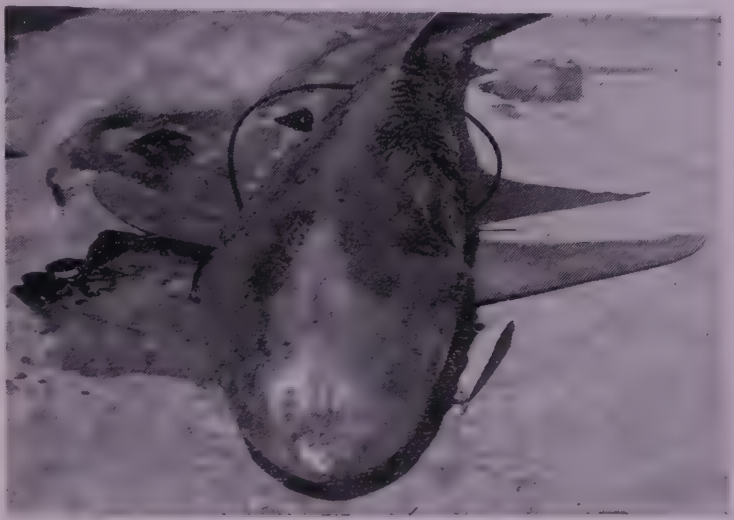

Fig. 1. Close frontal view of *C. obscurus.*

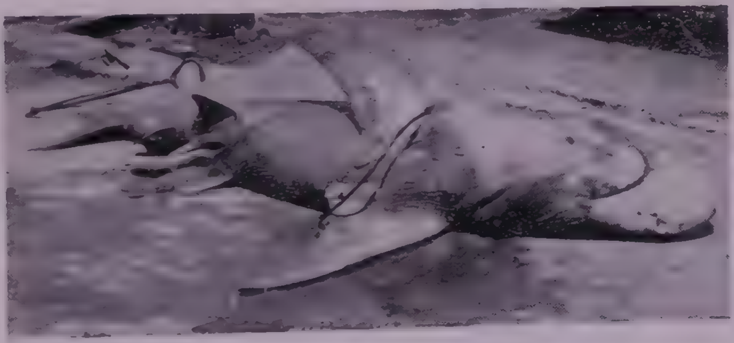

Fig. 2. Ventral view of *C. obscurus* showing the ring pierced through the pectoral fin.

The ring around the specimen was black and had no joint or marking. Tag or label was not present. The diameter of the ring was 28.64 cm and the thickness was 0.56 cm. The ring is preserved in the Veraval Research Centre of CMFRI.

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*Prepared by A. P. Lipton, S. G. Raje, Ravi Fotedar and Ranjit Singh, Veraval Research Centre of CMFRI with the technical assistance of Thumber and Zala.

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COCHIN, INDIA

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

THE MARINE FISHERIES INFORMATION SERVICE: Technical and Extension Series envisages the rapid dissemination of information on marine and brackish water fishery resources and allied data available with the National Marine Living Resources Data Centre (NMLRDC) and the Research Divisions of the Institute, results of proven researches for transfer of technology to the fish farmers and industry and of other relevant information needed for Research and Development efforts in the marine fisheries sector.

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Front cover photo:

A view of fish landed by bag netters at Navabunder (Gujarat) being sorted out.

Back cover photo:

A view of ribbon fish being dried.

A STUDY ON 'DOL' NET FISHERY AT SELECTED CENTRES IN NORTHWEST COAST WITH SPECIAL REFERENCE TO COSTS AND RETURNS

D.B.S. Sehara and J.P. Karbhari
Central Marine Fisheries Research Institute, Cochin

Introduction

Along the west coast of India, Maharashtra and Gujarat are two important states in respect of marine fish landing. About one-third of the total catch of the country is produced in nine coastal districts of Gujarat and five coastal districts of Maharashtra. More than 25 per cent of pelagic catch in the country comes from these two states. About 90 per cent of total catch in Maharashtra and 70 per cent in Gujarat are contributed by mechanised sector. 'Dol' netters (bagnetters) contributed 48 per cent of catch of mechanised sector in Maharashtra and 23 per cent in Gujarat during 1983–'84. Among pelagic fishes, dominating species of 'dol' catch along the northwest coast include Bombay duck, ribbon fish, pomfret, seerfish, penaeid prawn, 'jawla' *(Acetes* spp.) and sciaenids.

Keeping in view the importance of 'dol' fishery in northwest coast, the Central Marine Fisheries Research Institute, Cochin has undertaken a study on the 'dol' operation. The main objectives of the study were (i) to estimate returns to capital and net income to owners; (ii) to compare income levels of owners and wage earners on 'dol' units.

Methodology

For selection of 'dol' operating landing centres, ten centres covering Raigadh, Greater Bombay and Thane districts in Maharashtra and eight centres covering Valsad, Amreli and Junagadh districts in south and Saurashtra region of Gujarat were visited during 1984. Preliminary information regarding availability of infrastructure facilities, number and type of crafts and gears and the system of 'dol' operation were collected from fishing villages/landing centres through a schedule.

Three types of base systems attached with 'dol' operations were observed in northwest coast. In Raigadh District, big wooden pylons *(Khambas* or *Medhas)* fixed in sea bed serve as stands for 'dol' net operation. In Greater Bombay District wooden spikes *(Khunt)* laid in muddy sea floor attached with strong nylon ropes to them serve as bases for 'dol' net operation. Heavy stones *(Kaba)* are laid in the sea floor and the accessory nylon ropes are attached to them to make base for 'dol' net operation in Junagadh District of Gujarat. The method of 'dol' operation in Greater Bombay and Junagadh districts is popularly known as 'Sus'.

Based on peculiar characteristics of the three 'dol' operating systems, two villages in Maharashtra namely Navedar–Navgaon (*Khamba* system) and Mudh *(Khunt-sus* system) and one in Saurashtra namely Navabunder *(Kaba-sus* system) were selected for costs and returns study. At each centre, details of boat, engine and net, availability of credit facilities and other relevant information were collected from 20 randomly selected units. Operating expenditure and catch particulars (including price) from sample units were recorded on five systematically selected sample days each month for a period of one year, starting from September, 1984 through a schedule designed for this study. The enumerators were engaged locally from fishermen community and trained for data collection. The enumeration work was supervised periodically by the officers associated with the project.

Fishing season of 'dol' operation limited to nine months in a year was divided into three quarters based on good (post-monsoon), lean (winter) and moderate (summer/pre-monsoon) catch and the data was analysed quarterwise; mentioned here as quarters I (September–November), II (December February) and III (March-May). Important constituents of catch categorised for analysis, included Bombay duck, prawns, pomfret, seer fish, ribbon fish, croakers, Indian cod, *Coilia*, other fishes and 'kuta' (trash fish). The value of the catch was taken as the gross income of a unit.

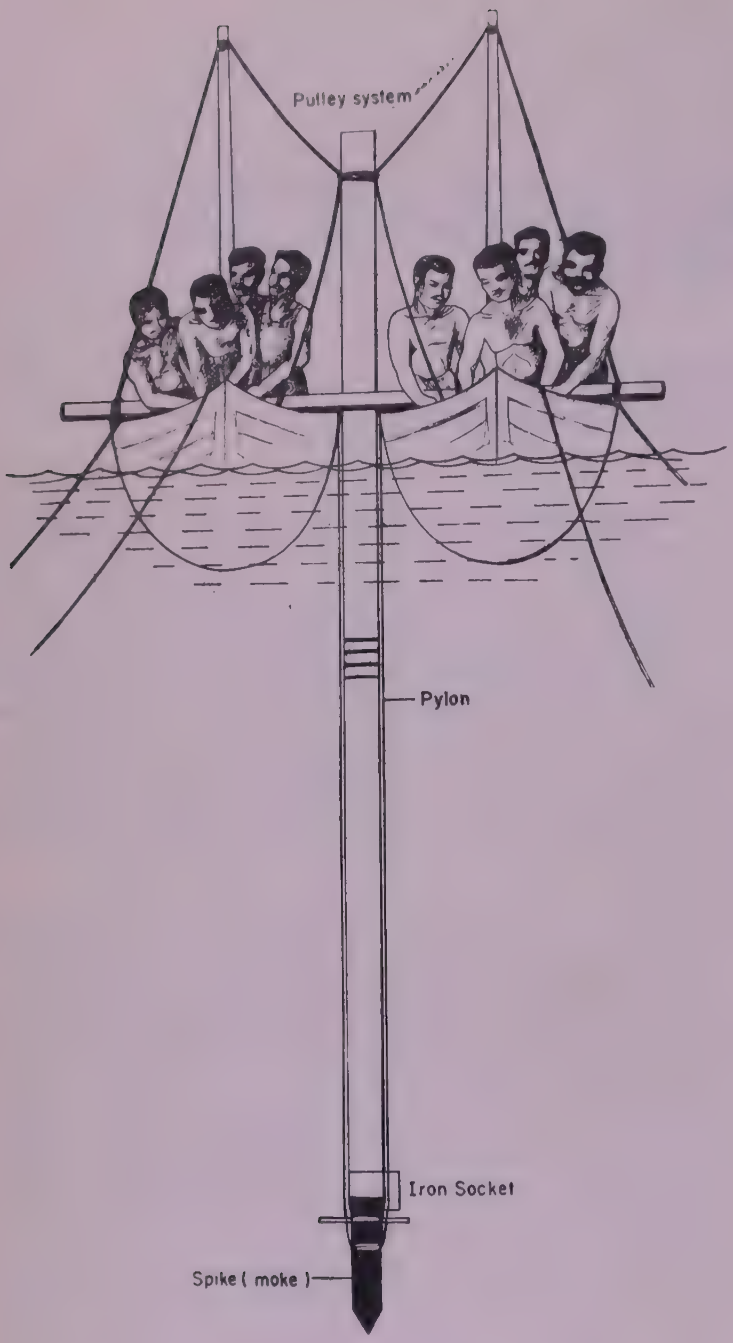


Fig. 1. Fixation of *khamba* at Navedar - Navgaon.

General information about the selected centres

Navedar–Navgaon is about 7 km from Alibag, the district headquarters of Raigadh in Maharashtra. There are about 500 fishermen families belonging to *Koli (Vaiti)* community. About 70 mechanised boats operate 'dol' at this centre. The centre lacks jetty facility. Boat building yard, engine repair workshop, electricity and drinking water facilities are available in the village. The Fishermen Co-operative Society provides fishing implements, diesel/oil, kerosene, household items and canteen facilities to the fishermen. It also provides transport facilities and help the fishermen in procuring loan and subsidy from state fisheries department.

In Madh, out of 620 fishermen families, about 300 are Christians (Catholics) and the rest Hindus *(Kolis)*. About 350 boats (80% mechanised and 20% non-mechanised) operate at this centre. Madh, better known as Madh Island comes under Greater Bombay District of Maharashtra. It has got *pukka* road, electricity and drinking water facilities but lacks jetty facility. Two fishermen co-operatetive societies are functioning. One of the societies provides fishing implements, diesel/oil and other fishery requisites to its 350 members and the other fish transport facility. The society also acts as a commission agent between fishermen and traders. One ice factory and cold storage are run by the society.

Navabunder, about 10 km from Una Taluk headquarters is one of the important landing centres for Bombay duck in Saurashtra, Gujarat. Besides about 300 fishermen of the village, a good number of fishermen, migrate to this centre every year in September–October from south Gujarat for fishing. Fifteen boats procured recently through National Co-operative Development Corporation in Nandan village also land their catch at this centre. In the village, two fishermen co-operative societies are defunct at present. During post-monsoon quarter more than 500 boats operate at this centre.

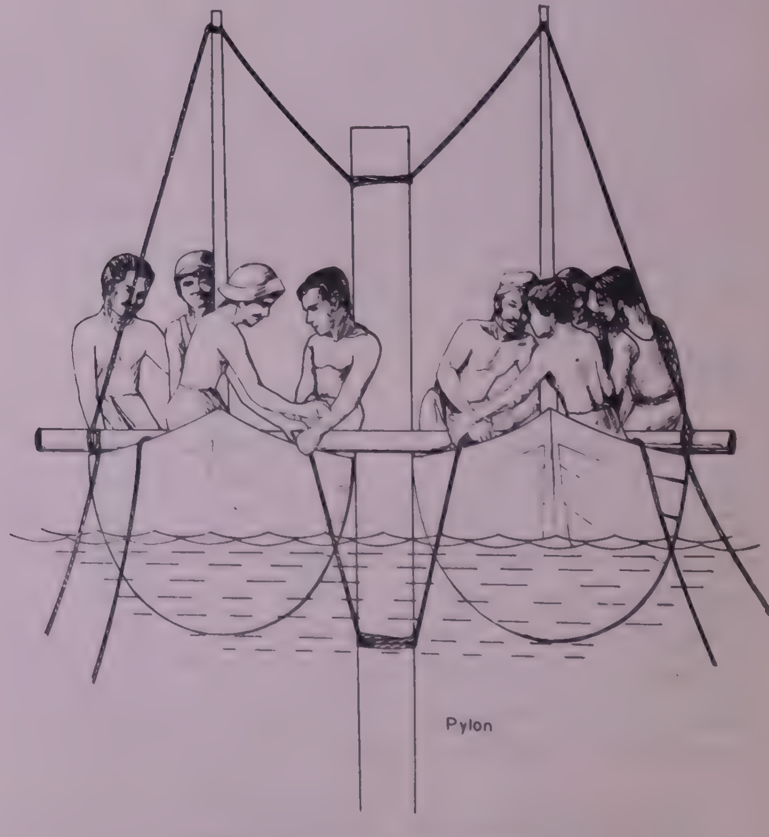


Fig. 2. Fixation of *khamba*.

Amenities like electricity, *pukka* road and jetty are available but drinking water facility is yet to be provided.

Khamba/Medha

Operating 'dol' with *khamba/medha* (wooden pylon) is the peculiarity of about 10 fishing centres from Rewas to Revdanda in Raigadh District (Maharashtra). The *khamba* varies from 15 to 36 m (8 to 20 wam; 1 wam is about 1.8 m) in length and 0.2–0.3 m in diameter in Navedar–Navgaon. It is made up of two kinds of wood namely teak wood (locally called 'sag') and wild wood (locally called 'haid'). A small *khamba* costs Rs. 7–8 thousand whereas big one Rs. 15–18 thousand. In addition, a few cheaper and small sized *khambas* made from locally available wood such as casuarina, coconut and palm trees are laid in inshore waters. A *khamba* has 5–6 joints and needs repairs and replacement of damaged joints especially during monsoon.

After the cessation of monsoon *khambas* are laid during neap tide *(Bhang)* in the water in different depths depending upon the availability of fish. The *khambas* are taken out from sea in the end of May of the following year. These are protected from rain water and preserved from decaying by covering with mud in creek during monsoon. Generally, 4 *khambas* are laid, for operating 3 'dols', in 4-8 fathoms in post-monsoon, 8–10 fathoms in winter and 10–15 fathoms in summer season.

Fixation of *khambas* is done with the help of two boats tied together by means of two logs put horizontally (Fig. 1). The upper end of the *khamba* is connected with a rope to a pulley-arrangement at mast head of two boats. The wooden-pylon is raised vertically and carefully lowered towards the sea floor by 15–20 persons in the boats. The rise and fall of sea level through waves act as a powerful force to drive the spike (lowermost end of pylon fitted with iron socket) into the sea bed. The rope tied to pylon is loosened when water level comes up. and tightened when the level goes down. Thus powerful downward thrust of wave is exerted on pylon driving it deeper and deeper till it is fixed firmly. The pylon is driven about 4.5 to 6.0 m deep into the sea floor and projected 3.0 to 4.5 m above surface of water. A peculiar contrivance, locally called 'khuda' is fixed with each pylon at the bottom which is useful in 'dol' net operation with ease (Fig. 3).

Khunt-sus system

This method is prevalent in Ratnagiri, Greater Bombay, Thane and partly Raigadh districts of Maharashtra. The *sus* system at Madh contains wooden anchor *(Khunt)*, garfil rope and float *(buoys)*. The *khunt*, 1.8 to 2.1 m length and 0.3–0.6 m in breadth is made up of palm or coconut tree. As shown in Fig. 4, *khunt* is pointed at one end and embeded in the muddy sea floor in the same way as pylon is fixed. *Khunt* laying into sea floor is done mainly in the month of September during neap tide *(Bhang)*. The *khunt* is fixed by hammering through *khamba* tied with the two boats and helped by up and down movement of the water. This takes 3–4 hours and involves 12–15 crew members. The *khunt* so fixed into the sea floor remains fixed for about three years. Two garfil ropes depending on the depth of the 'dol' operation are fastened to *khunt*. The base

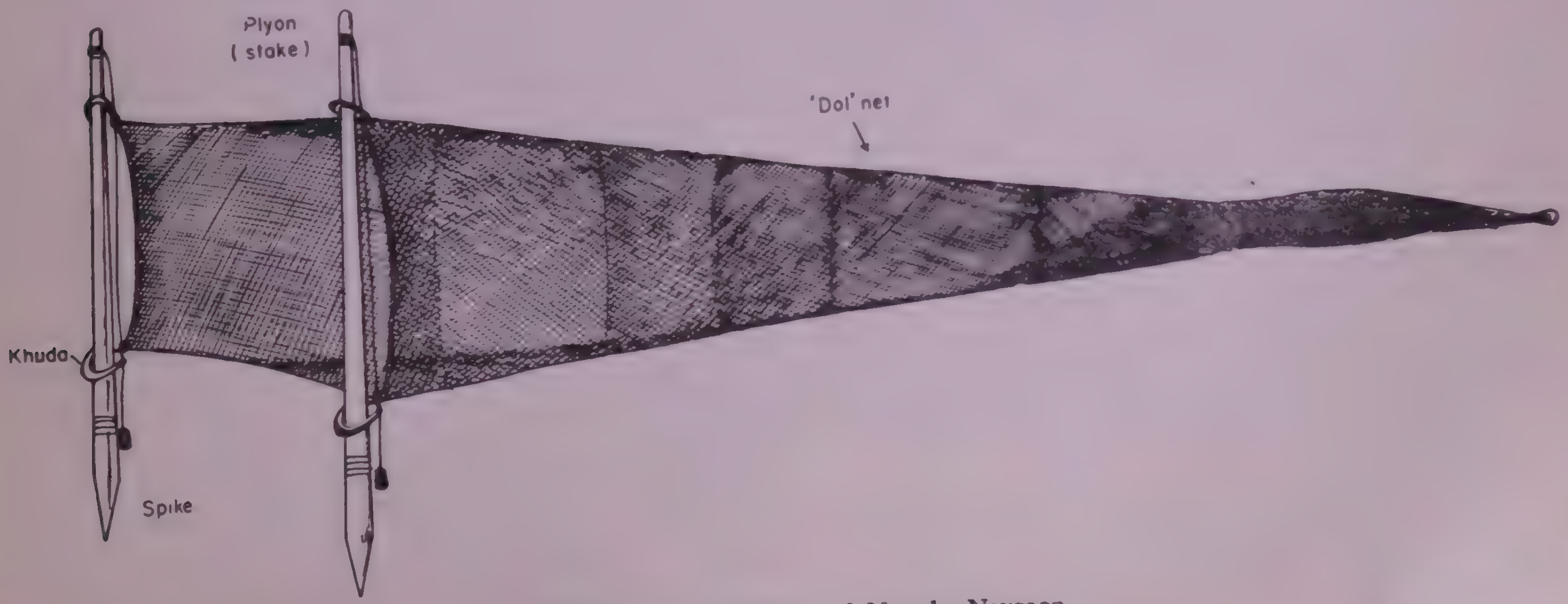


Fig. 3. 'Dol' operation of Navedar-Navgaon.

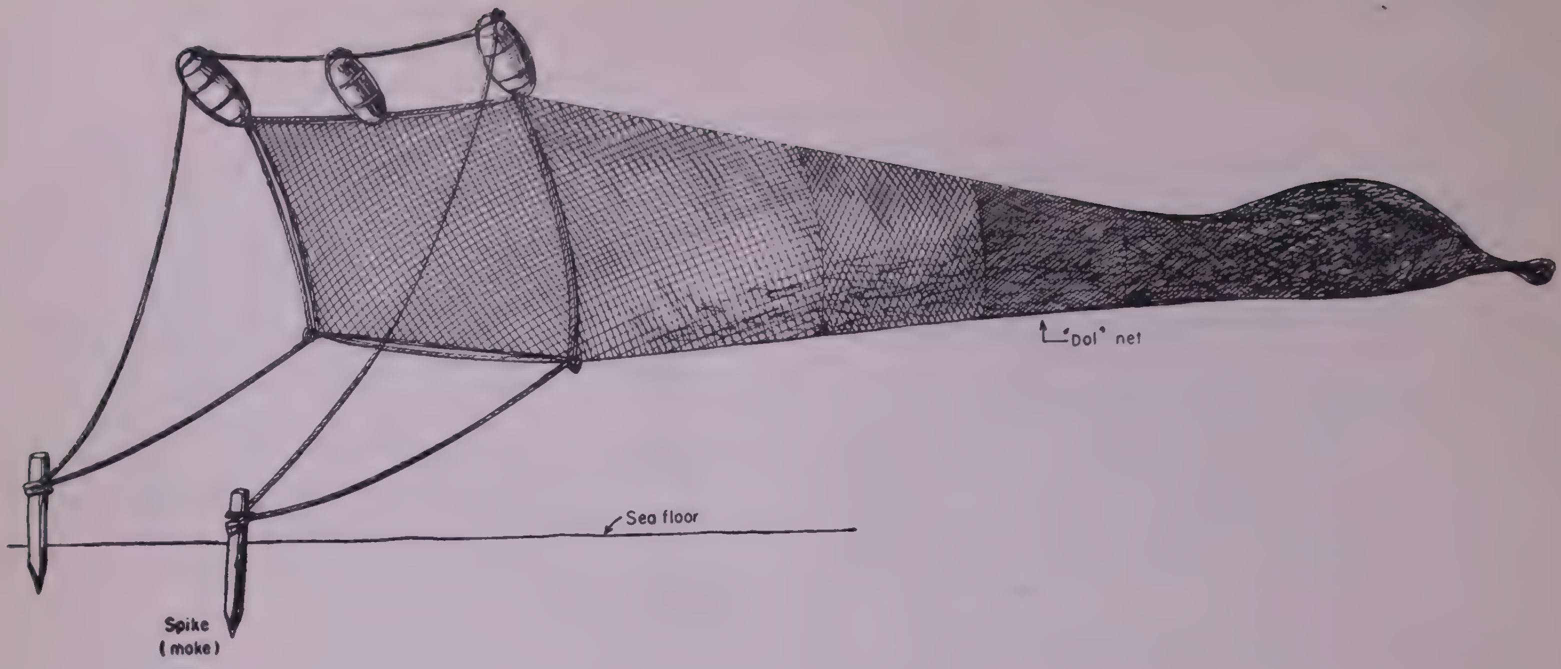


Fig. 4. 'Dol' operation in Sus at Madh.

ropes suspended in the water are supported with the help of floats made up of wood or plastic (known as *pimp* or *buoya)*. 'Dol' net is tied with the help of base ropes and operated.

Kaba-sus system

This system of 'dol' fishery is prevalent in Valsad, Amreli and Junagadh districts of Gujarat. This *sus* has a striking difference from the *sus* adopted in Maharashtra, particularly in making use of stones for anchor instead of wooden *khunt*. The *sus* at Navabunder, locally called as *kaba* (Fig. 5) can be divided into three components - stone anchor, anchor ropes and floats (buoys). The stones are excavated from nearby quaries and supplied to fishermen through co-operative societies of stone cutters. One 'dol' needs two heaps of stones, each containing 50–60 stones. After the fishing season is over these heaps cannot be used for next year. In this region the use of wooden anchor *(khunt)* or pylon *(khamba)* is not possible due to very strong water currents. In a *kaba-sus*, there are 7 sets of anchor ropes, locally known as *Jotha, Lambudu, Hendoro, Sher, Uthab Sethu* and *Karcha*. Barrel buoys which are tied to the basal rope give support to keep it in upward position.

To put *Kaba*, first the anchor rope is lowered to the bottom from the boat with the help of heavy stone tied at one end of the rope *(sher)* till it touches the sea floor. The remaining stones tied with thin coir ropes are deposited along the *sher* one after another so as to get stones distributed evenly around the basal end of *sher*. In this way anchor rope is securedly fixed and other end of the rope is tied with the barrel buoys touching surface of the water. Generally six *kabas* are required to operate three 'dol' nets. After the closing of 'dol' fishery in May part of the anchor ropes is salvaged but the stones-anchor is a total loss.

Details of 'dol' (bagnet)

'Dol' is conical in shape with wide rectangular opening (mouth) and tapering cod end. The net varies from 45 to 73 m in length with a circumference of mouth ranging from 45 to 70 m. It is made up of 'polyethylene monofilament plastic twine'. 'Dol' resembles trawlnet but being stationary it is used to capture column fish. In Maharashtra, six segments of 'dol' starting from opening to cod end, are known as *Mohar* (8.5–10.7 m), *Chirate* (6.7–11.0 m), *Katra* (11.0–15.0 m), *Manjuwala* (9.8–13.7 m), *Munj* (4.8–8.5 m) and *Khola* (4.8–7.6 m). In Saurashtra, eight sections of 'dol' are named as *Bochi* (1.2–1.5 m), *Mathadu* (12.0–13.7 m), *Malkhadu* (2.4–3.6 m), *Oar* (16.7–20.0 m), *Trijo* (9.0–12.0 m), *Bangu* (3.0–4.6 m), *Chothi* (2.4–4.6 m) and *Jalo* (3.0–5.5 m). A nylon 'dol' net costs Rs. 7–9 thousand. The mesh size differs in each section and is reduced from mouth to cod end. The cod end is made up of double layers to give additional strength as the entire catch is collected in the cod end with the force of current. The net is set to face the incoming current and when the tide starts receding the position of the net is reversed.

Fishing craft

Bagnetters, varied from 9–14 m in length, 2–3.6 m in breadth and 1–1.8 m in height in Navedar–Navgaon. Most of them are fitted with 2–4 cylinder diesel engine. The cost of a mechanised craft varied from Rs. 1.1 lakhs to Rs. 2.0 lakhs. A wide variation of 5 to 14 tonnes was found in carrying capacity of boats. About 50% of the boats are more than 10 years old.

The boats at Madh centre varied from 8.5–12.8 m in length, 1.5–3.6 m in breadth and 0.8–1.2 m in height with the tonnage varying from 2 to 10. The boats are fitted with 2–4 cylinder diesel engine. Most of the boats and engines were purchased during the period from 1970 to 1980 and were with single family ownership.

At Navabunder the bagnetters are 10–12.8 m in length, 2.4–3.6 m in breadth and 1–1.8 m in height with tonnage varying from 4 to 12. The boats were fitted with 3–4 cylinder engines. The cost of engine and boat varied from Rs. 1.3 lakhs to Rs. 2.2 lakhs.

Share system and crew payment

Catch sharing system prevails on majority of units at Navgaon. If eight crew members are engaged in a unit, the catch (after deducting the operating cost) is divided into 13 parts. Of these, five shares go for boat, engine, *khamba* and net and the rest are divided equally among the crew members *(Khapnara)*. All repair charges including that of boat, engine, net and *khamba* are borne by the owners. Women labourers charge Re. 1 per basket for transporting and loading/unloading of catch. Some women labourers are paid in kind (about $\frac{1}{4}$ of owner's share) for sorting and drying of catch and making platforms.

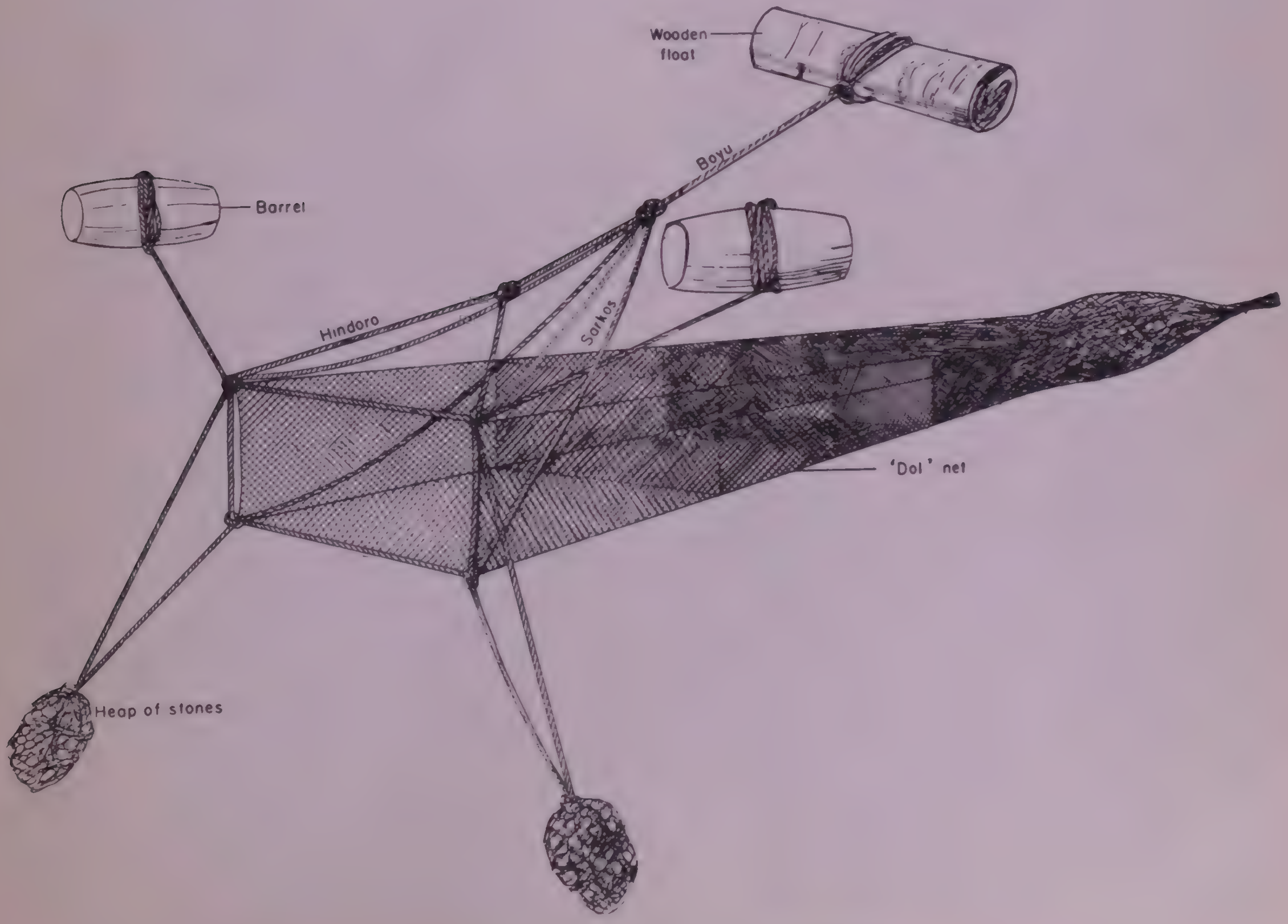
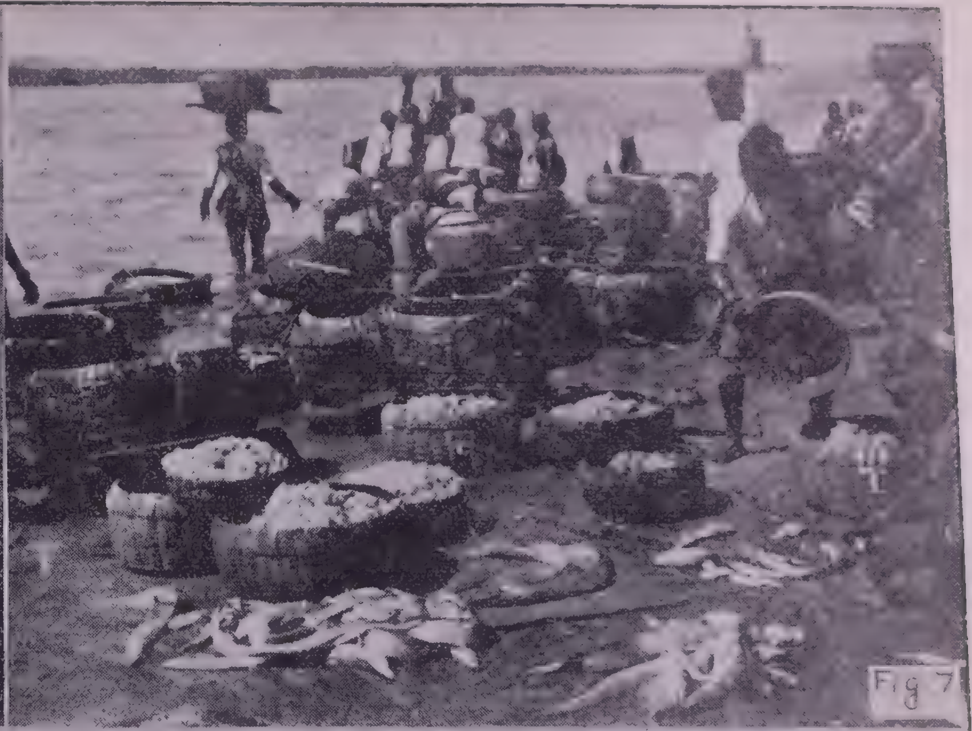


Fig. 5. 'Dol' operation in *sus* at Navabunder.



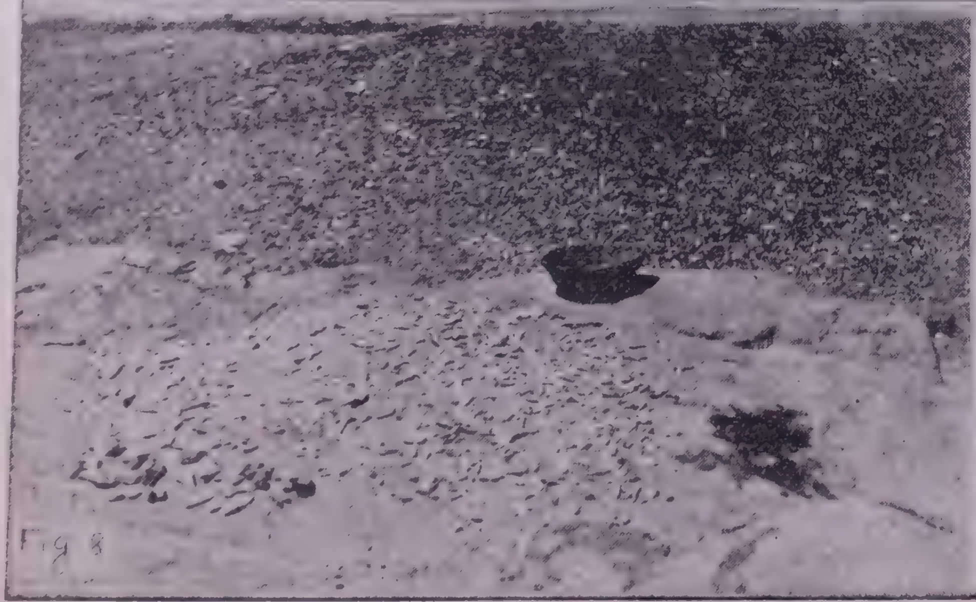


Fig. 6. Mechanised 'dol' netters at Navabunder (Gujarat). Fig. 7. A view of fish landed by 'dol' netters at Madh (Greater Bombay). Fig. 8. Non-penaeid prawns (at back ground) and miscellaneous fishes (in the fore-front) caught in the 'dol' net are being sun-dried on beach in Madh. Fig. 9. Fisherman are collecting their shares as their wages, a typical system prevailing on Maharashtra coast.

In Madh (Maharashtra) and Navabunder (Saurashtra, Gujarat) the crew (known as *Khapnara* at Madh and *Khalasi* at Navabunder) are paid in cash varying from Rs. 5,000 to Rs. 7,000 each for a fishing season of nine months starting from September. Labourers are contracted for one fishing season and paid advances. Besides this they are provided with food, *pan, bidi etc.* on the boat. For sorting, drying, loading/unloading and transportation of catch, women labourers are paid both in cash and kind.

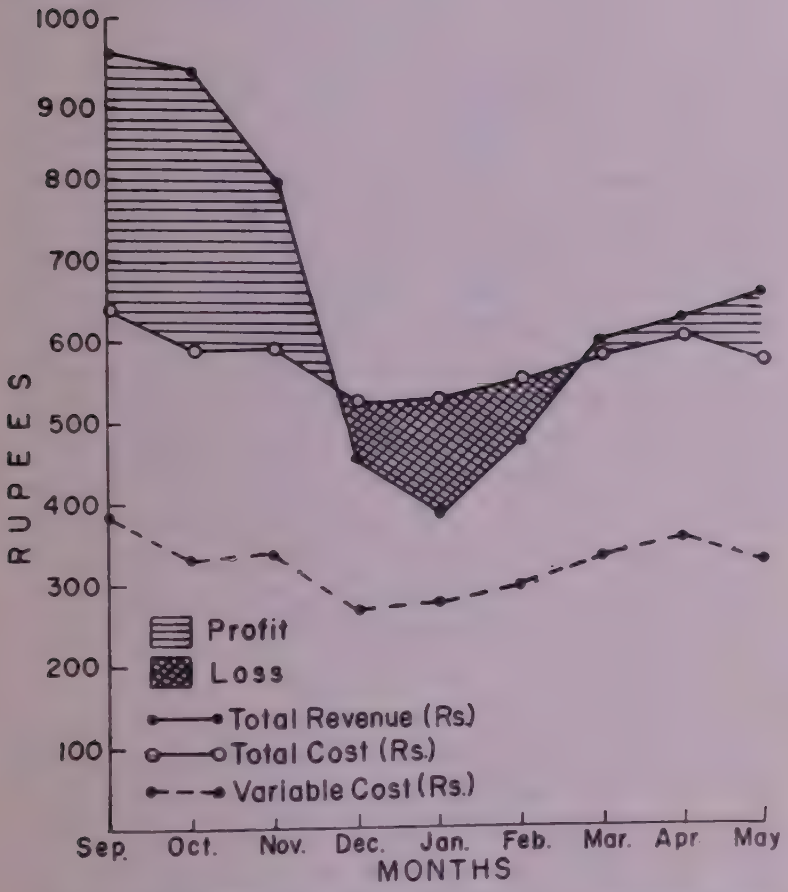


Fig. 10. Monthwise profit/loss (Rs./day) at Navgaon centre during 1984–'85.

Preservation and marketing of catch

In Navedar–Navgaon, non-penaeid prawn *(Jawla)*, Indian–cod and ribbon fish are dried and sold in *Mandla* (get-together held on 7th lunar day) to fish traders coming from Mahad, Poona, Sholapur and Satara. The non-penaeid prawns are graded as *Diswill* (best quality), *Safed* (medium quality), *Lal* (low quality) and *Kuta* (mixed) and priced accordingly. Ice is used for storing the quality fishes which are sold by lady vendors locally.

Fresh catch at Madh is transported in society's trucks to wholesale fish market at Malad (14 km), by charging Rs. 3/- per basket and sold to fish traders through Fishermen Co-operative Society. Commission of 6 % from fishermen and 2 % from traders is charged on the value of catch sold. Quality fishes are sold in Shivaji wholesale fish market. Sundried catch including non-penaeid prawn, Bombay-duck and ribbon fish is sold in the village itself to private traders. An amount of Rs. 150–200 is paid as rent of plot used for fish drying.

At Navabunder centre, the catch is sold to fish traders directly. Ribbon fish, Bombay duck, *Coilia* and '*dhoma*' are sundried and sold to the traders of Shivri (Bombay) and Navabunder itself. The traders provide advances to fishermen and pay less price for the catch. *Mandla* is arranged for selling dry fish on 11th lunar day and the price is fixed for 15 days to one month period. The ice is used in summer for preservation of quality fishes.

Credit facilities

Fishermen in Navgaon availed loan from banks and Government for procuring boat, engine and net. Unlike in other villages, taking loan from private agencies was not popular in this village. In Mudh, Indian Bank, Central Bank, Bank of India and Dena Bank provided finance to fishermen. Few units have been provided on loan from N. C. D. C. and State Fisheries Department at lower interest rates through Fishermen Co-operative Society. At Navabunder, fishermen have availed loan from commercial banks, District Co-operative Bank and N.C.D.C. Majority of fishermen avail loan from fish traders and hypothecate their catch against loans. Rate of interest on the loan availed from institutional agencies varied from 9 to 13 % per annum. The loan was availed for purchasing craft/gear or operating expenditure.

Discussion

Number of fishing days

'Dol' operating is confined to 9 months in a year, starting from September, and throughout the northwest coast it remains suspended during the monsoon. Number of annual 'dol' operating days ranged from 245 in Navedar–Navgaon to 253 in Madh. The number of fishing days was more in the villages where crew members were contracted by boat owners compared to those where they shared catch and operating expenditure with

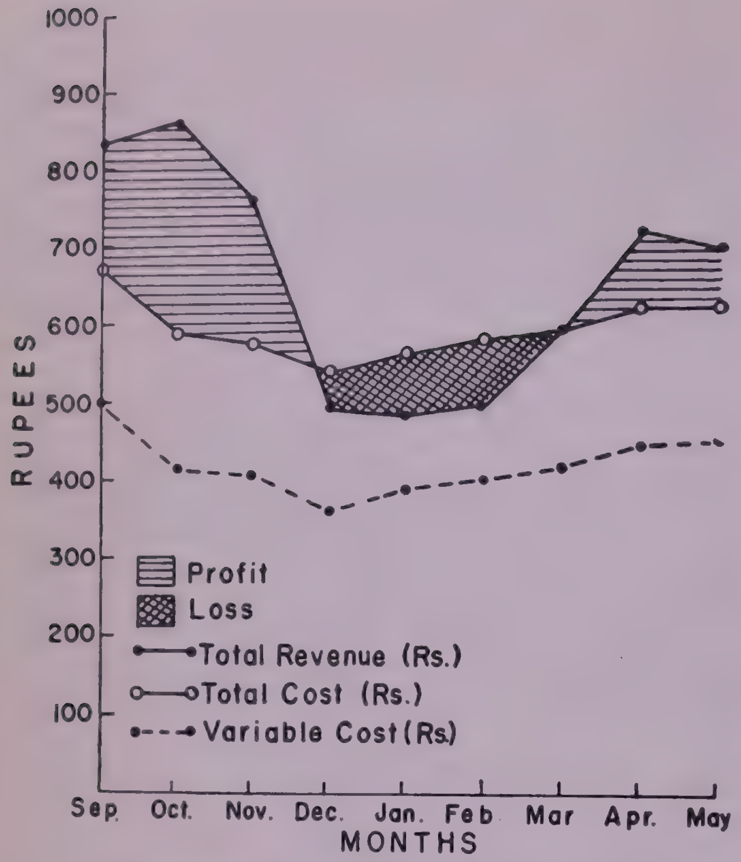


Fig. 11. Monthwise profit/loss (Rs./day) at Madh centre during 1984–'85.

the boat owners. No significant difference was observed in the number of fishing days between post-monsoon (80–87 days), winter (83–85 days) and pre-monsoon (81–83 days) quarters. 'Dol' was operated 2–4 times a day (24 hours).

Catch particulars

Bombay duck, prawns, seer fish, pomfret, croakers and ribbon fish were common fishes available at the selected centres. The catch composition varied from centre to centre and season to season. At Navedar–Navgaon percentage of prawns in total catch increased from 19 in post-monsoon to 36 in pre-monsoon quarter (following year). Bombay duck accounted for 24.8% of total catch in I quarter whereas contribution in subsequent quarters was very low (1–2 %). The share of ribbon fish in catch was highest in I quarter (31.1%) and lowest in II quarter (13.9%). There was a good catch of Indian cod in II and III quarter forming 24.5 and 13.6 % of total catch respectively. Of the total catch, about 5% belonged to other species (eels, cat fish, clupeoids, sharks *etc.*) throughout the year. *Kuta* (unsorted small size fish/trash fish) formed about 11–18% of total catch in different quarters at this centre. The catch consisted of 6–9% commercially important fishes like seer fish, pomfret and croakers. There was a wide variation in per day catch of I (415 kg), II (187 kg) and III (300 kg) quarter. For the whole fishing season, the average per day catch of a unit was calculated at 298.7 kg. Bombay duck, prawns, ribbon fish and Indian cod formed majority of catch (about 75%). Monthwise analysis showed a maximum catch of 452 kg per operating day landed in October and minimum of 162 kg per day in January. Sometimes 'dol' net operation becomes difficult in winter due to strong wind, affecting the catch adversely.

At Madh centre, penaeid and non-penaeid prawns formed about 53% of annual catch. Maximum contribution of Bombay duck was noted in I quarter (11.5%) and minimum in II quarter (1.1%). Second important species at the centre was ribbon fish contributing the highest of 19.7% of catch in III quarter and the lowest of 7.6% in II quarter. Seer fish and pomfret formed 2–3% and croakers 8–10% of total catch. Average catch of a unit was calculated at 344 kg per operating day. The share of I, II and III quarter in total catch was about 48, 22 and 30% respectively. Prawns and ribbon fish together contributed about 68 % towards the catch. Monthwise analysis showed maximum per day catch in October (523 kg). The catch declined in subsequent months upto 210 kg but again increased in last quarter upto 342 kg. Average catch of a unit was worked out to 87,013 kg during the study year.

Bombay duck and ribbon fish together formed about 54% of total catch at Navabunder centre. The contribution of Bombay duck was highest in I quarter (47.7%) and lowest in III quarter (9.5%) whereas ribbon fish trend was just reverse, contributing highest in III quarter (51.3%) and lowest in I quarter (11.3%). There was a good catch of croakers and *Coilia*, in winter, contributing 12.7 and 20.8% respectively. The catch on an average amounted to 465.3 kg/day in I quarter. 210.6 kg/day in II quarter and 322.8 kg/day in III quarter. Croakers, *Coilia*, prawns and seer fish/pomfret accounted for 10.2, 8.6, 4.0 and 2.4% of annual catch respectively. Total catch of a unit was noted as 82,854 kg during 1984–'85.

Coefficient of variation in per day catch at Navgaon, Madh and Navabunder was 22, 18 and 24% respectively within the units and 35, 35 and 37% respectively within the months. Higher variations within the months reflected seasonal fluctuation in catch availability at all the centres.

Cost of production

a) Fixed cost: At Navedar-Navgaon, the capital investment (Rs. 2,36,000) included the cost of boat and engine (Rs. 1,40,000), nets (Rs. 21,000) and *khamba* (Rs. 75,000). The annual depreciation of craft (10%), gear (33.3%) and *khamba* (20%) was worked out to Rs. 14,000, Rs. 7,000 and Rs. 15,000 respectively (Table 1). Taking 11.25% rate of interest on capital, the amount of interest was calculated at Rs. 26,550 per annum. The total annual fixed cost was worked out to Rs. 62,550 per unit. At Madh and Navabunder, the total annual fixed cost was Rs. 40,450 and Rs. 46,038 respectively.

b) Variable cost or operating expenditure: As given in Table 1, the annual variable cost of a 'dol' unit in *khamba* system at Navgaon was worked out to Rs. 79,275 which formed about 56% of total cost (Rs. 1,41,825). About 46% of the operating expenditure was incurred on labour - crew and those employed for loading/unloading, sorting and drying of the catch. Fuel, the second major cost item accounted for 35.5% of the expenditure. An average amount of Rs. 3,700 was spent on boat, engine and net repairs. Transportation, preservation and marketing charges accounted for 5.5% of the variable cost.

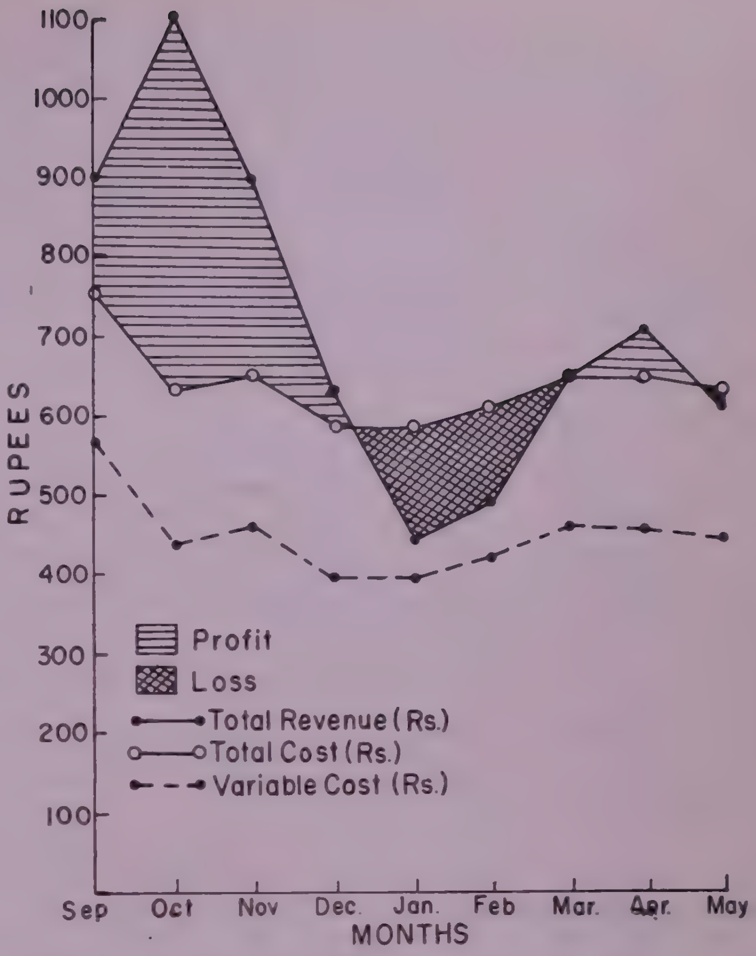


Fig. 12. Monthwise profit/loss (Rs./day) at Navabunder centre during 1984–'85.

Table 1. *Details of annual fixed and variable cost of 'dol' operation*

Annual expenditure/Centres		Navedar-Navgaon (*Khamba* system)	Madh (*Sus* system)	Navabunder (*Sus* system)
a) Fixed cost (Rs)				
i) Depreciation on boat and engine		14,000	14.000	16,000
ii) Depreciation on 'dol'		7,000	8 000	9,000
iii) Depreciation on *Khamba*		15,000	—	—
iv) Interest on initial investment		26.550	18,450	21.038
Total		62,550	40,450	46,038
b) Variable cost (Rs)				
i) Fuel (diesel & oil) charges		28,175 (35.5)	32,890 (31.1)	33,750 (30.0)
ii) Labour	(a) active fishermen	34,290 (43.3)	42,126 (39.9)	41,500 (36.9)
	(b) fishery allied activities	2,450 (3.1)	5,060 (4.8)	12,500 (11.1)
iii) *Khamba/Sus* maintenance		760 (1.0)	7 000 (6.6)	9,000 (8.0)
iv) Boat, engine & net repairs		3,700 (4.7)	4,100 (3.9)	3,950 (3.5)
v) Construction & maintenance of hut/shed/ drying stands and rent of plot		2.100 (2.6)	3,550 (3.4)	3,800 (3.4)
vi) Transportation, marketing and preservation		5,080 (6.4)	7,400 (7.0)	5,050 (4.5)
vii) Miscellaneous items (ropes, basket, bucket, mat, fare, donations *etc.*)		2,720 (3.4)	3,479 (3.3)	2,950 (2.6)
Total		79,275 (100)	1,05,605 (100)	1,12,500 (100)
Total annual expenditure (a + b)		1,41,825	1,46,055	1,58,538

Note: Figures in parentheses show the percentages of variable cost.

Table 2. *Quarterwise details of operating expenditure (Rs.) of 'dol'*

Items/Centres	Navedar-Navgaon Quarters				Madh Quarters				Navabunder Quarters			
	I	II	III	Annual	I	II	III	Annual	I	II	III	Annual
a) Cost of fuel (diesel & oil)	8,734	9,016	10,425	28,175	9,867	10,854	12,169	32,890	10,125	11,475	12,150	33,750
	(31.4)	(38.0)	(37.7)	(35.5)	(25.9)	(34.3)	(33.9)	(31.1)	(25.5)	(33.0)	(31.9)	(30.0)
b) Labour charges:												
i) Active fishing	12,036	10,580	11,674	34,290	14,323	13,801	14,002	42,126	14,203	13,412	13,885	41,500
	(43.2)	(44.5)	(42.2)	(43.2)	(37.6)	(43.7)	(39.0)	(39.9)	(35.8)	(38.6)	(36.5)	(36.9)
ii) Engaged in fishery allied activities	990	660	800	2,450	2,024	1,316	1,720	5,060	4,875	3.125	4,500	12,500
	(3.6)	(2.8)	(2.9)	(3.2)	(5.3)	(4.2)	(4.8)	(4.8)	(12.3)	(8.9)	(11.8)	(11.1)
c) Maintenance cost of *khamba/sus*	300	205	255	760	2,800	1,750	2,450	7,000	3,150	2,880	2,970	9,000
	(1.1)	(0.9)	(0.9)	(1.0)	(7.3)	(5.5)	(6.8)	(6.6)	(7.9)	(8.3)	(7.8)	(8.0)
d) Maintenance & repair cost of boat, engine and net	1,850	740	1,110	3,700	2,050	820	1,230	4,100	1,778	1,185	987	3,950
	(6.6)	(3.1)	(4.0)	(4.7)	(5.4)	(2.6)	(3.4)	(3.9)	(4.5)	(3.4)	(2.6)	(3.5)
e) Cost of construction & maintenance of hut/shed, drying stands & rent of plots	840	580	680	2,100	2,485	355	710	3,550	2,280	684	836	3,800
	(3.0)	(2.4)	(2.5)	(2.6)	(6.5)	(1.1)	(2.0)	(3.4)	(5.7)	(2.0)	(2.2)	(3.4)
f) Expenditure on transportation, marketing & preservation	2,032	1,270	1,778	5,080	3,108	1,850	2,442	7,400	2,020	1,262	1,768	5,050
	(7.3)	(5.3)	(6.4)	(6.4)	(8.2)	(5.8)	(6.8)	(7.0)	(5.1)	(3.6)	(4.7)	(4.5)
g) Miscellaneous expenditure	1,061	707	952	2,720	1,461	870	1,148	3,479	1,239	767	944	2,950
	(3.8)	(3.0)	(3.4)	(3.4)	(3.8)	(2.8)	(3.3)	(3.3)	(3.2)	(2.2)	(2.5)	(2.6)
Total	27,843	23.758	27,674	79,275	38,118	31,616	35,871	1,05,605	39.670	34,790	38,040	1,12,500
	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)

Note: Figures given in parentheses show the percentages.

Table 3. *Measures of economic efficiency of 'dol' units*

Economic parameters/Centres	Navedar-Navgaon	Madh	Navabunder
a) Gross income (Rs)	1,60,241 (654.1)	1,66.479 (658.0)	1,80,623 (722.5)
b) Net cash flow (Rs)	80,965 (330.5)	60,874 (240.6)	68,123 (272.5)
c) Net unit income (Rs)	44,966 (183.6)	38,874 (153.6)	43,123 (172.5)
d) Unit earnings (Rs)	47,416 (193.6)	41,404 (163.6)	45,623 (182.5)
e) Family labour earnings (Rs)	20,866 (85.2)	22,954 (90.7)	24,585 (98.3)
f) Net profit of the owner (Rs)	18,416 (75.2)	20,424 (80.7)	22,085 (88.3)
g) Operating cost–cash flow ratio	0.98	1.73	1.65
h) Fixed cost–cash flow ratio	0.39	0.24	0.26
i) Total cost–cash flow ratio	1.8	2.4	2.3
j) Rate of capital turnover (%)	67.9	101.5	96.6
k) Pay back period (years)	4.3	3.9	4.0
l) Profit % of investment	7.8	12.4	11.8

Note: Figures in parentheses show the income/earnings per fishing day.

Quarterly analysis showed that 35% of annual operating expenditure was incurred in I, 30% in II and 35% in III quarter (Table 2). Maximum operating expenditure of Rs. 385 per day was worked out for September and minimum of Rs. 270 per day for December.

Fuel (diesel & oil) cost varied from Rs. 8,734 in I quarter to Rs. 10,425 in III quarter. Labour charges were maximum in I quarter (Rs. 13,026) and minimum in II quarter (Rs. 11,240). Reduction in labour engagement in winter was due to decline in fish landings and fishery allied activities. Similarly, expenditure on repairs of craft and gear, construction of shed and fish drying stands, transportation and marketing was maximum in I quarter and minimum in II quarter. Monthly analysis of expenditure showed maximum fuel consumption in March (Rs. 4,010) and minimum in September (Rs. 2,293). About 30% of expenditure on repairs of craft and gear and 17 % on maintenance of shed and fish drying stands was incurred in September though number of fishing days were minimum (22 days) in this month. Labour, transportation, marketing and fuel charges were positively correlated with number of fishing days in a month within the quarters. Expenditure on the maintenance of *khamba* and miscellaneous items (baskets, mat, rope *etc.*) had mixed trend over the months. Average monthly operating expenditure was minimum in February (Rs. 7,489) and maximum in April(Rs. 10,035).

Annual operating expenditure of a 'dol' unit at Madh was about 72% of the total cost (Rs. 1,46,055).

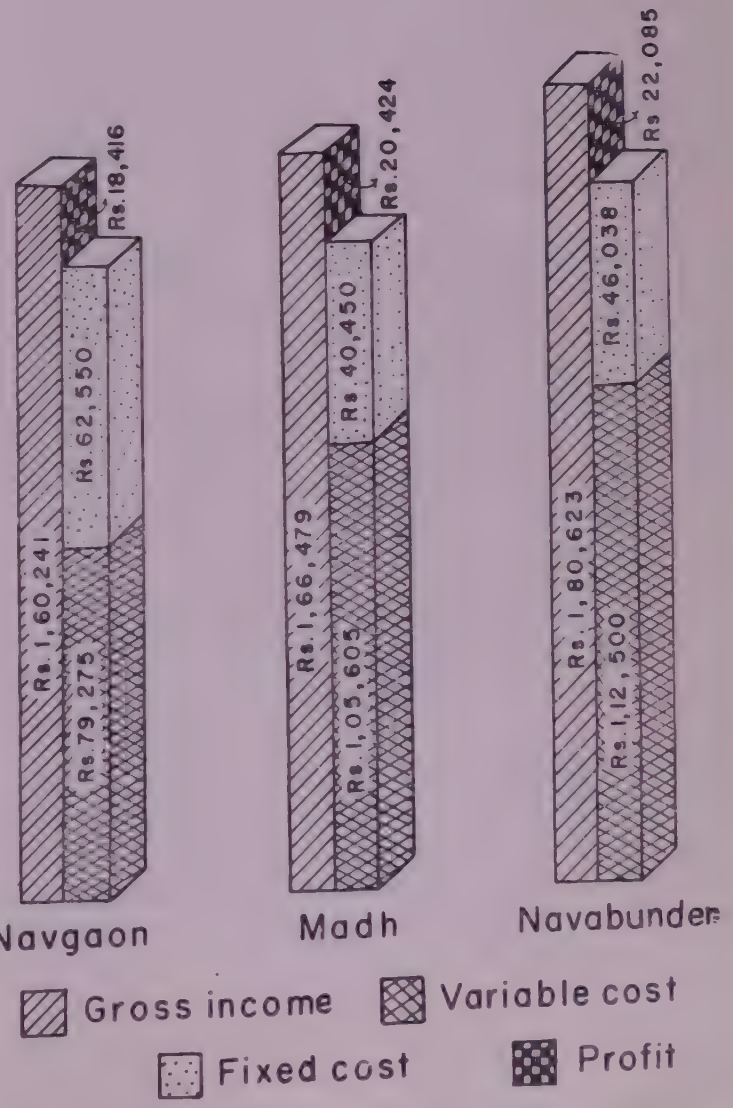


Fig. 13. Annual income, cost and profit during 1984–'85.

Of variable cost, labour charges formed about 44%. An amount of Rs. 31,500 was paid as wages for nine months fishing season and an amount of Rs. 10,626 was spent on food and other personal expenditure of the crew. For those employed in fishery allied activities (generally women) the annual payment totalled Rs. 5,060. *Sus* installation and maintenance cost amounted to Rs. 7,000. Of variable cost boat, engine and net repair formed about 4%. Annual cost of marketing, transportation and preservation of catch was Rs. 7,400. Amount spent on purchase of basket, rope, mat and other miscellaneous items accounted for 3.3% of operating cost.

Quarterly operating expenditure varied from a minimum of Rs. 31,616 in winter to a maximum of Rs. 38,118 in summer. Since *sus* was installed in deeper water in summer, the fuel expenditure was highest in this quarter (37%). There was not much change in labour charges over the seasons (Rs. 15–16 thousand) as the crew members were contracted for nine months period. Of annual expenditure on *sus* about 40% was incurred in I quarter. Similarly 50% of annual amount spent on repairs of craft and gear and 70% on construction of shed and fish drying stands was recorded for I quarter. Expenditure on transportation, marketing and preservation was maximum in I quarter (Rs. 3,108) and minimum in II quarter (Rs. 1,850).

Monthwise break-up showed a minimum fuel expenditure of Rs. 2,948 in September and a maximum of Rs. 4,308 in March. No significant difference was observed in the crew wages over months. *Sus* expenditure was maximum in September (Rs. 1,500) forming 21.4% of the annual amount. Similarly amount spent on repairs of crafts and gear, maintenance and construction of hut/shed and fish drying stands and marketing was maximum in September as compared to following months. No significant difference was noted in monthly expenditure within the quarters. On the whole, the variable cost of a unit was calculated at Rs. 417.4 per day.

At Navabunder, the annual operating expenditure of a 'dol' unit was Rs. 1,12,500 (71% of total cost). Of the operating cost. 30% was spent on fuel in 250 fishing days. Crew wages formed about 37% of the annual expenditure. Loading/unloading, sorting and drying charges totalled to Rs. 12,500 per annum. Each unit engaged 4–6 women labourers for this job. Expenditure on installation of *sus* amounted to Rs. 9,000 per unit. An amount of Rs. 3.950 was spent on boat, engine and net repairs. Maintenance of shed and drying stands costed Rs. 3,800 per annum. Transportation, marketing and preservation of catch accounted for 4.5% of variable cost. Miscellaneous expenditure aggregated to about Rs. 3,000.

Quarterly break-up of expenditure showed that among three quarters maximum expenditure was noted in I quarter (Rs. 39,670) and minimum in II (Rs. 34,790). About one-third of the annual variable cost was recorded for III quarter. Fuel expenditure varied from Rs. 10,125 in I quarter to Rs. 12,150 in III quarter. Crew wages had no significant change over quarters (Rs. 13–14 thousand). Women labourers were paid a maximum amount of about Rs. 4,800 in post-monsoon quarter and a minimum of about Rs. 3,000 in winter. Reduction of labour was due to the low catch in winter. There was not much variation in maintenance cost of *sus* over the quarters. Amount spent on repairs of craft and gear was maximum in I quarter (Rs. 1,778) and minimum in III quarter (Rs. 987). About 60% of the expenditure on the construction of shed and stand was incurred in I quarter. The highest percentage of transportation, marketing and preservation cost was observed in I quarter (40%) and lowest in II quarter (25%). Miscellaneous expenditure maintained almost the same trend.

Cost-comparison between months revealed minimum fuel consumption in September (Rs. 2,964) and maximum in March (Rs. 4,392). There was no difference worth mentioning in crew wages over the months. Payment for labour engaged in fishery allied activities accounted lowest in February (Rs. 956) and highest in October (Rs. 1,784). Amount spent on *sus* maintenance was maximum in September (Rs. 1,550) and minimum in November (Rs. 740). Charges on repairs of craft and gear varied from Rs. 220 in October to Rs. 1,105 in September. Maintenance cost of shed and drying yards ranged from Rs. 200 in January to Rs. 1,550 in September. Preservation and marketing expenditure was minimum in February (Rs. 200) and maximum in October (Rs. 740). Miscellaneous expenditure was comparatively high in September (Rs. 440). Variable cost per operating day was worked out to Rs. 450 which ranged from Rs. 395 in December and January to Rs. 463 in March.

c) Total cost: Sum of variable and fixed cost was worked out to Rs. 1,41,825 per unit at Navgaon. For *sus* system, total cost was Rs. 1,46,055 at Madh and Rs. 1,58,538 at Navabunder. Though fixed cost was more in Navgaon in comparison of other two villages, the total annual cost was less owing to substantially low variable cost at this centre. The annual cost per operating day was Rs. 634 at Navabunder. At Navgaon and Madh per day operating cost was almost the same (Rs. 577 & 579).

Income and economic efficiency measurers (Table 3)

a) Gross income: At Navgaon, annual gross income of a unit was Rs. 1,60,241 for 245 fishing days. Of gross income about 45% was earned in I quarter, 23% in II quarter and 32% in III quarter. Seer fish/pomfret, ribbon fish, prawn, Indian cod and Bombay duck were the important fishes contributing 24.8, 21.1, 18.0, 11.3 and 9.0% respectively towards gross income. Of total catch value in I quarter (Rs. 71,405) highest contribution was made by seer fish/pomfret (32.6%), followed by ribbon fish (25.3%) and Bombay duck (16.7%). In winter, highest contributor was Indian cod (26.8%) followed by non-penaeid prawn (22.7%). About 81% of the income in III quarter was obtained from non-penaeid prawns (24.5%), ribbon fish (23.0%), seer fish/pomfret (18.6%) and Indian cod (15.3%). During nine months fishing season, gross earning per day (Fig. 6) was highest in October (Rs. 936) and lowest in January (Rs. 392). No significant difference was observed in income between the months during III quarter. Value of catch per operating day averaged Rs. 654. The gross income per operating day was maximum in I quarter (Rs. 892) and minimum in II quarter (Rs. 446).

With the *sus* system of 'dol' net operation, annual gross earning of a unit in Madh was Rs. 1,66,479. About 43% of income was obtained in I quarter, 24% in II quarter and 33% in III quarter. Of the annual income, about 36% was obtained from non-penaeid prawns, 19% from seer fish/pomfret, 16.2% from croakers, 11% from ribbon fish and 8.2% from Bombay duck. Percentage contribution of prawns to the gross income was highest in winter (43.4%) and lowest in post-monsoon quarter (32.5%). Share of Bombay duck in gross income varied from 2.3% in winter to 13.7% in post-monsoon quarter. About 15% of gross income in III quarter was obtained from ribbon fish. Significant difference in per day income was observed between I (Rs. 818), II (Rs. 487.9) and III quarter (Rs. 660.4). Monthwise analysis showed a maximum income of Rs. 863 per day in October and a minimum of Rs. 479 per day in January (Fig. 7). Per day earning from prawns was maximum in November (Rs. 325), Bombay duck in September (Rs. 172), and croakers and ribbon fish in May (Rs. 184 & Rs. 119 respectively). Gross income of a unit was worked out to Rs. 658 per day.

At Navabunder, annual gross income of a unit was Rs. 1,80,623. Of the earnings, about 45% was recorded in I quarter, 25% in II quarter and 30% in III quarter. The value of per day catch in I, II and III quarter was Rs. 989.6, Rs. 522.5 and Rs. 663.4 respectively. In total income, share of prawns was 22.5%, Bombay duck 18.8%, seer fish/pomfret 15.8%, croakers 14.4% and ribbon fish 11.6%. In I quarter, highest contribution towards income was made by Bombay duck (27.6%) followed by prawns (19.8%). In II quarter percentage contribution of prawns (27.9%) was more than any other fish. In III quarter, ribbon fish was the highest contributor (23.8%) to the gross income. There was a decline in the percentage income obtained from Bombay duck from I to II quarter and then a marginal increase from II to III quarter. In winter *Coilia* added 12.5% to the quarterly revenue. The percentage of income obtained from croakers was highest in III quarter (16.8%) and lowest in I quarter (12.2%) The analysis further revealed that per day income of a unit (Fig. 8) was maximum in October (Rs. 1,103) and minimum in January (Rs. 446) averaging Rs. 722.5 for fishing season.

b) Net cash flow: For *khamba* system at Navgaon the net cash flow of a unit during the study year amounted to Rs. 80,966, averaging Rs. 330.5 per operating day. For *sus* system, the net cash flow over operating cost was about Rs. 61,000 at Madh and Rs. 68,000 at Navabunder. The income per operating day for *sus* system (Rs. 241–272) was less than that of *khamba* system (Rs. 330).

c) Net unit income: Net unit income was calculated by deducting depreciation from net cash flow. For *khamba* system the income was about Rs. 45,000 in Navgaon. Net unit income at Madh and Navabunder, for *sus* system, was found to be Rs. 38,874 and Rs. 43,123 respectively. The income of a unit ranged from Rs. 154 to 184 per operating day at these centres.

d) Unit earning: The sum of value of the produce (fish) used in the house during study year and the net unit income formed the unit earning. It was estimated that fish worth Rs. 10 was consumed per day and accordingly, unit annual earning was calculated at Rs. 47,416 at Navgaon, Rs. 41,404 at Madh and Rs. 45,623 at Navabunder.

e) Family labour earning: It was derived by deducting the interest on capital from the unit earning. For *sus* system, family labour earning per operating day ranged from Rs. 91 at Madh to Rs. 98 at Navabunder. At Navgaon, on *khamba* system, the annual family income was about Rs. 21,000 averaging Rs. 85.2 per operating day.

f) Net profit of the owner: Net profit of the owner was derived by deducting the value of produce consumed in the house from the family earning. As shown in Fig. 9 net profit was maximum at Navabunder (Rs. 22,085 per annum) and minimum at Navgaon (Rs. 18,416 per annum). The net profit (income) per operating day ranged from Rs. 75 to Rs. 88.

g) Operating cost ratio: Operating cost ratio is a measure to compare the quantum of operating cost against gross profit. For Navgaon the ratio was worked out to 0.98. The ratio of operating expenses to the gross profit (cash flow) was higher for Madh (1.73) and Navabunder (1.65). Comparatively low operating cost and higher net cash flow at Navgaon resulted in lower operating cost ratio.

h) Fixed cost ratio; Fixed cost ratio or overhead charges ratio was minimum for Madh (0.24) and maximum for Navgaon (0.39). Additional amount of depreciation on *khamba* resulted in higher fixed cost at Navgaon as compared to other centres which accounted for higher fixed cost ratio at this centre.

Gross cost ratio was almost the same on *sus* system (2.3 to 2.4) for Madh and Navabunder. For Navgaon the ratio was 1.8 on *khamba* system.

i) Rate of capital turnover: The rate of capital turnover was about 68 % in Navgaon. For *sus* it ranged from 96.6% at Navabunder to 101.5% at Madh. Reverse to this, capital per 100 gross profit was lowest for Madh (98.5%) and highest for Navgaon (147.3%).

j) Payback period: Payback period was calculated on dividing the initial investment by the sum of net profit and depreciation. Results revealed that the period required to recover capital investment was about four years both for *sus* and *khamba* systems.

k) Profit investment ratio: Annual net profit accounted for is about 12% of total investment for *sus* system and about 8% for *khamba* system. Net profit being comparatively less and investment high for *khamba*, the profit investment ratio was low for *khamba* at Navgaon. If annual interest is added to the profit, the returns on investment comes to about 19% for *khamba* and 24% for *sus*.

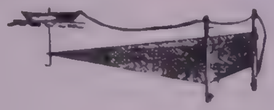
Highlights of the study

1. Main constituents of 'dol' catch were non-penaeid prawns, ribbon fish and Bombay duck at Navgaon (about 65%), non-penaeid prawns and ribbon fish at Madh (68%) and Bombay-duck, prawns, croakers and ribbon fish at Navabunder (about 67%).
2. Post-monsoon quarter contributed 45–49% towards the annual catch and 43–45% towards the gross income at the selected centres.
3. In winter, the catch of all species declined drastically but Indian cod at Navgaon and *Coilia* at Navabunder registered increase in catch, contributing 24.5 and 20.8 % towards the catch of the quarter respectively.
4. The number of annual operating days ranged from 245 to 253.
5. Initial investment was more for *khamba* system as compared to *sus*.
6. The variable cost per operating day ranged from Rs. 324 for *khamba* system at Navgaon to Rs. 450 for *sus* at Navabunder.
7. For a fishing season of nine months a labourer was paid about Rs. 6,000. Labour charges formed 37–43% of the variable cost.
8. Fuel, the second major operating expenditure, constituted 30-36%.
9. Net profit per operating day was more for *sus* system (Rs. 81-88) than *khamba* (Rs. 75).
10. Rate of capital turnover was lowest at Navgaon (68%) and highest at Madh (102%).
11. Payback period was found about 4 years for both *sus* and *khamba* systems.

12. Based on net profit and initial capital investment the *sus* system of 'dol' operation was found more economical. In Madh, *khamba* system, which prevailed in '50s and early '60s, has been completely replaced by *sus*.

Acknowledgement

The authors are grateful to Dr. P. S. B. R. James, Director, CMFRI, for his guidance and encouragement in conducting this study.



NOTE ON THE EXPLOITATION OF EDIBLE OYSTERS IN KOVALAM-MUTTUKADU BACKWATERS, MADRAS*

Existence of edible oyster beds in the backwaters, lagoons and estuaries along both the coasts of India is well known. Exploitation of these beds is irregular and erratic and nowhere a sustenance fishery for these molluscs exists at present. Moreover, fishing of oysters is done mainly for the value of shells.

Unusually heavy exploitation of the beds of edible oysters was observed at Kovalam-Muttukadu backwaters, near Madras, where existence of rich beds of edible oysters was reported recently. Of the six beds demarcated, the bed to the west of Muttukadu bridge was observed to be the most extensive The total area of the bed was 26.068 m^2 with an estimated biomass of 417 tonnes. The dense population of oysters was found to form a reef. The bed was subjected to exposure during extreme low tides.

During the period from 25th January to 21st February, 1987, the above bed was fished by men and women folk from nearby villages of Kunnakadu, Padur and Thaiyoor. Those who were exploiting the bed were not traditional fishermen but were mostly agriculture labourers, who took to fishing of oysters as an off-season venture to supplement their income.

Fishing was carried out during day time only on all the days, when the tide was low. Oysters available in clusters and heaps in the bed were removed using crow bars. Dislodged oysters were kept in heaps on the bed itself (Fig. 1), till they were removed to the shore using catamarans (Fig. 2). A maximum of eight catamarans were engaged during the peak period of exploitation. The oysters kept on the shore were sold to entrepreneurs of lime industry at the rate of Rs. 4/- per one basket of 50 kg capacity. Each fisherman/woman could fish upto 8 to 10 baskets per day thus earning a remuneration of Rs. 32 to 40. The oysters were then, kept in open to allow the flesh to decompose and the shells to dry (Figs. 3 & 4). Later, they were transported by trucks to lime kilns at Palavakkam, Kovalam and Tambaram.

From 25–1–'87 to 21–2–'87, a total number of 476 persons were engaged in the fishing, landing 364 tonnes of oysters from the bed. The size range of oysters was 11-183 mm, indicating removal of adult oysters as well as spat.

It was understood from the fisherfolk that such exploitation of oyster beds at Kovalam–Muttukadu backwaters was done once in four or five years, when the oyster beds were exploited to the maximum extent possible. Even the subfossil deposits are not spared during these operations. This year it was noticed that 87.3% of the total biomass of oysters was removed, which may lead to denudation and may prevent further formation of oyster beds in the area. Apart from the removal of live oysters the quarrying of subfossil deposits on such occasions may prove to be destructive to the beds in the long run. This has to be guarded against.

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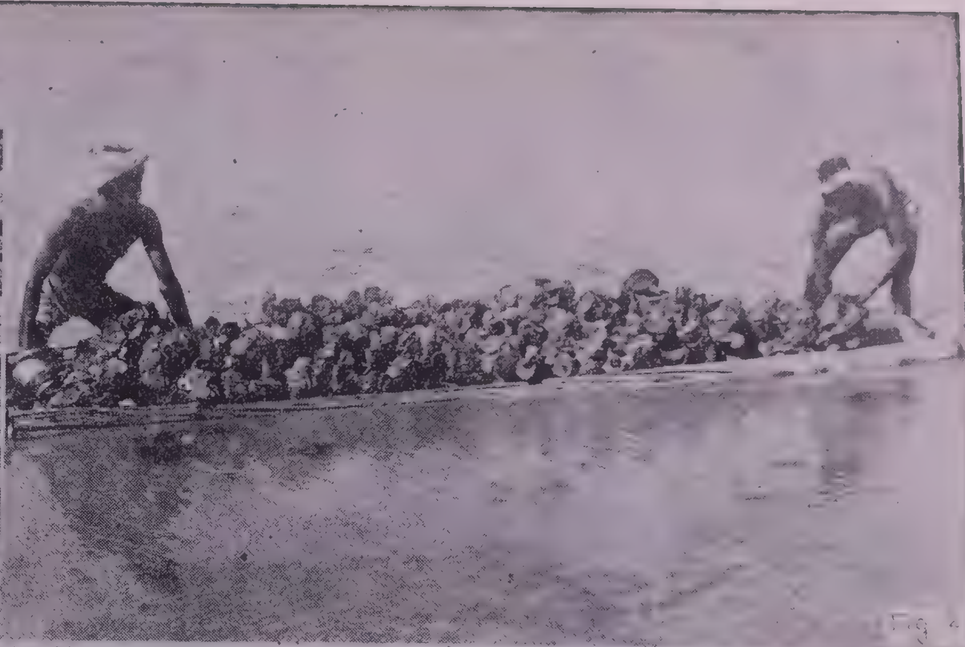
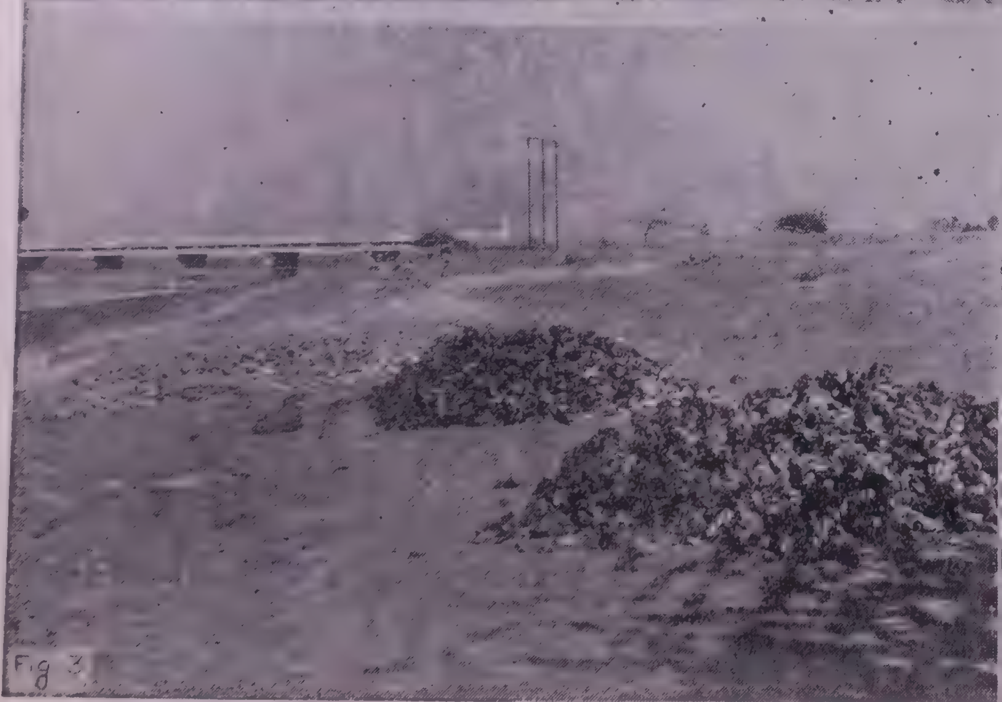
*Prepared by P. V. Sreenivasan, R. Thangavelu, R. Sarvesan and P. Poovannan, Madras Research Centre of CMFRI, Madras.





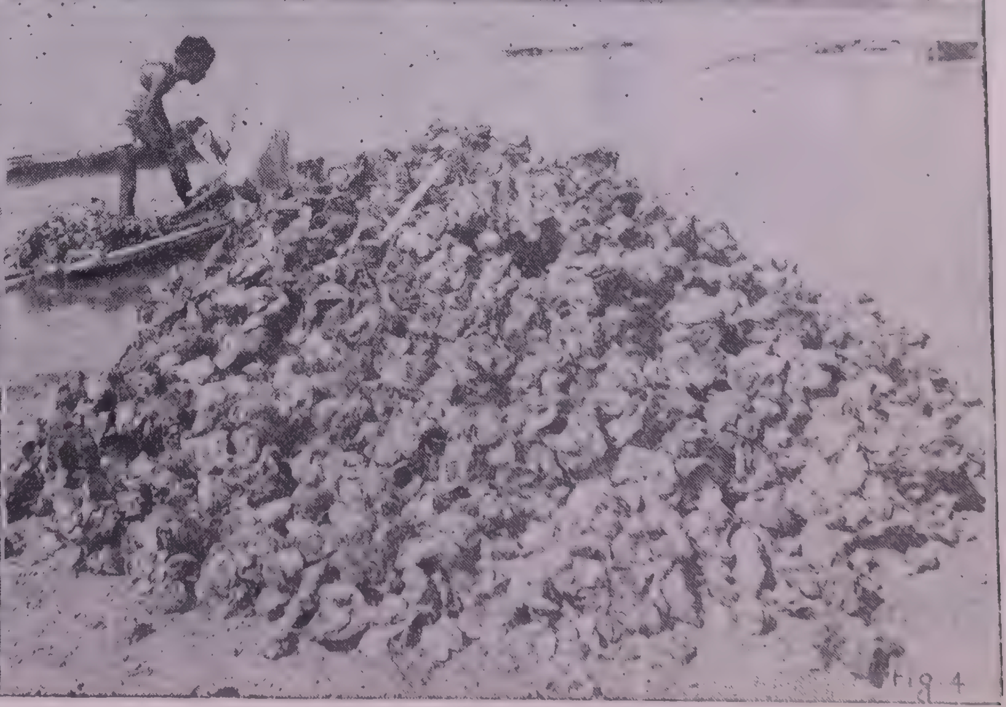


Fig. 1. Fished out oyster heaps kept at the oyster bed. Pits dugged for sub-fossil shells can also be seen. Fig. 2. Oysters being transported by canoes. Fig. 3. Oyster heaps on the shore. Fig. 4. A closer view of the oysters.

ON A BALEEN WHALE LANDED AT HOLLENGADE, KARNATAKA COAST*

A dead whale belonging to the genus *Balaenoptera* was washed ashore in the evening of 29th April, 1987 at Hollengade 7 km south of Kumta. The whale was in a decomposed condition when landed and hence detailed measurements could not be taken. The total length was about 17 m.

It is further reported that another whale measuring 13.7 m was washed ashore on 16th April, 1987 at Nadibag near Ankola.

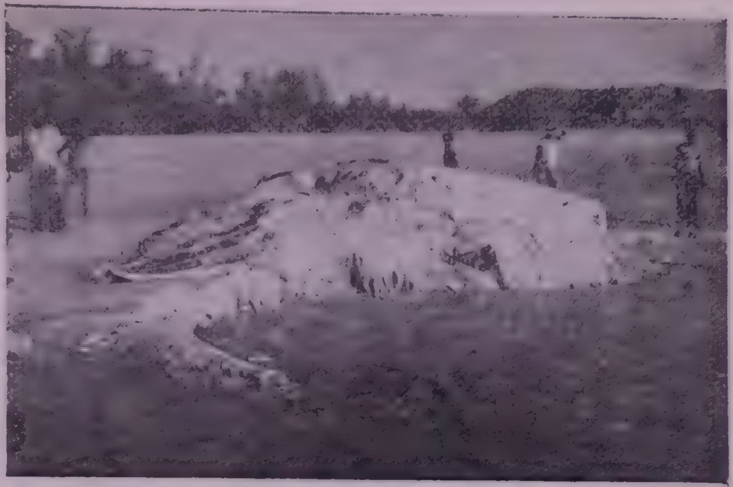


Fig. 1. Dead whale washed ashore at Hollengade (near Kumta) on 29-4-'87.

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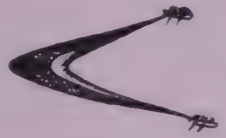
*Reported by K. Y. Telang, Karwar Research Centre of CMFRI, Karwar.



NYLON MADE SHORE SEINE TO CATCH MORE FISH*

Introduction

Koprivanipeta and Mulapeta are two important marine fish landings centres in East Godavari District in Andhra Pradesh. A common shore seine used here for catching the nearshore fishes is the 'Pedda alivivala' made of cotton twine. Recently transparent nylon twine has been introduced here to fabricate this gear. The nylon made shore seine has been found to catch more fish besides having several advantages over the cotton net. The light weight of the net facilitates easy operation and handling. This has also reduced the time required for operating the net. In this way the fishermen could increase the number of hauls which means more catch. The use of transparent twine makes it invisible to the fish and therefore very little fish tend to escape from the net. The fishermen can save time required for drying the net.

The newly introduced nylon shore seine is in operation along this coast from September, 1986. By the end of the year there were about seven nets of the above type at Koprivanipeta and 14 at Mulapeta. The new net is getting popularised in the neighbouring centres also.

Description of gear

The 'Pedda alivivala' consists of 61 webbed pieces laced together, each piece being of different dimensions (Fig. 1) to give an almost tapering finish to the net from the centre to both ends. The dimensions of each piece of the webbing are given in Table 1. A large marker buoy is attached to the centre piece for locating the net in water.

Round cement sinkers numbering 2,500, each one having a diameter of 80 mm and thickness of 20 mm are attached to the foot rope. Synthetic cylindrical floats numbering 100, each one having a diameter of 40 mm and a length of 115 mm, are attached to the head rope. The head rope is formed of two ropes; the float line and the mounting line. Similarly the foot rope also has two ropes the sinker line and the mounting line. Two wooden sticks of 50 cm length are tied to each end of the foot and head ropes (Fig. 1).

The webbing has three typical mesh sizes *i. e.* 14 mm (from pieces 1-10 and centre piece), 22 mm (from pieces 11-25) and 24 mm (from pieces 26 to 30). Each piece has a uniform length of 16.20 m except the centre piece which is 21.60 m. There is a gradual tapering from

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*Prepared by C. V. Seshagiri Rao, Kakinada Research Centre of CMFRI, Kakinada.

Table 1. *The dimensions of different webbed pieces on either side of centre webbed piece*

Serial number of pieces from either side of centre piece	Width (in m)	Length (in m)	Mesh size (in mm)
Centre piece	15.75	21.60	14
1st piece	13.50	16.20	14
2nd piece	13.05	16.20	14
3rd piece	12.60	16.20	14
4th piece	12.15	16.20	14
5th piece	11.70	16.20	14
6th piece	11.25	16.20	14
7th piece	11.80	16.20	14
8th piece	10.35	16.20	14
9th piece	9.90	16.20	14
10th piece	9.45	16.20	14
11th piece	9.00	16.20	22
12th piece	8.55	16.20	22
13th piece	8.10	16.20	22
14th piece	7.65	16.20	22
15th piece	7.20	16.20	22
16th piece	6.75	16.20	22
17th piece	6.30	16.20	22
18th piece	5.85	16.20	22
19th piece	5.40	16.20	22
20th piece	4.95	16.20	22
21st piece	4.50	16.20	22
22nd piece	4.05	16.20	22
23rd piece	3.60	16.20	22
24th piece	3.15	16.20	22
25th piece	2.70	16.20	22
26th piece	2.25	16.20	24
27th piece	1.80	16.20	24
28th piece	1.35	16.20	24
29th piece	0.90	16.20	24
30th piece	0.45	16.20	24

the centre to either end (Fig. 1) and therefore the width of each piece varies from 15.75 m for the centre piece to 0.45 m for the end piece. The total length of the shore seine is 507.6 m. The operation of this net is similar to any other shore seines and it lasts for 2.5 to 3 hours. The fishing is done in depths of 8-10 m.

The fishes caught in this gear include pelagic fishes namely *Sardinella* spp., Mackerel, *Stolephorus* and other clupeids and carangids. Silver bellies and penaeid prawn like *Metapenaeus dobsoni* are also caught. The shore seine operations start at the two landing centres by September and lasts till April with peak landing during October to March when the sea is calm.

At the time when the gear was introduced in September, 1986 its cost was about Rs. 88,300 which could be split up as under:

Webbed nylon twine @Rs. 160/- per kg	: Rs. 62,400 for 390 kg
Nylon rope for foot and head ropes @ Rs. 45/- per kg	: Rs. 11,250 for 250 kg
Nylon rope for warp (25mm diameter) @ Rs. 30/- per kg	: Rs. 6,000 for 200 kg
Synthetic floats @ Rs. 25/- per float	: Rs. 2,500 for 100 floats
Cement weight	: Rs. 300 for 2500 sinkers
Miscellaneous	: Rs. 2,850
Labour charges	: Rs. 3,000
Total	: Rs. 88,300

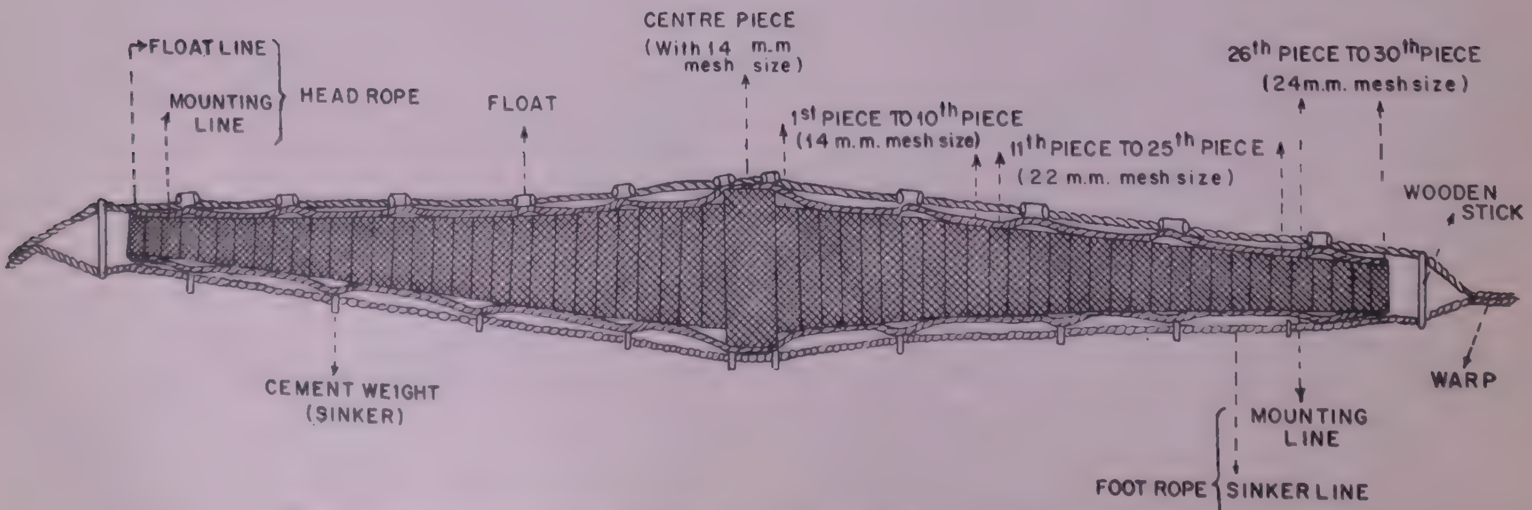
FLOAT LINE
MOUNTING LINE
HEAD ROPE
FLOAT
CENTRE PIECE (With 14 m.m mesh size)
1st PIECE TO 10th PIECE (14 m.m. mesh size)
11th PIECE TO 25th PIECE (22 m.m. mesh size)
26th PIECE TO 30th PIECE (24m.m. mesh size)
WOODEN STICK
WARP
CEMENT WEIGHT (SINKER)
MOUNTING LINE
FOOT ROPE
SINKER LINE

Fig. 1. The 'Pedda alivivala' the new nylon shore seine used along the Andhra coast.

AN ACCOUNT ON LIGHT-FISHING FOR THE CARANGID *SELAR CRUMENOPHTHALMUS*[*]

For the fishermen with outboard motors in many of the fishing centres of Trivandrum District in the southern part of Kerala coast, the new year 1987 was bright at least at its beginning. At these centres, for a fortnight from the 3rd week end of December, 1986, the days dawned with the motorised plank-built boats roaring back to the shore with bulk catches of the bigeye scad *Selar crumenophthalmus*, which were most abundant during the first five days of the new year. The catches were obtained by what is generally termed as light-fishing, where the fish were optically lured to an artifically lighted area near the surface to be fished by suitable gears. Light-fishing has so far been limited in the area experimentally to cephalopods.

Adoption of light fishing for capture of this carangid was incidental. One night, some fishermen fishing from motorised canoes about 20 km away from the shore had kept a bright torch to signal their presence, lest passing boats and ships should hit them. They soon noticed shoals of this fish coming up near the surface apparently lured by the unusually bright light. The news spread among the fishermen and from the next day onwards, the fishing ground 20 to 30 km off these centres became bright at night with hundreds of lighted mechanised crafts fishing around.

The source of light for each craft was 4 to 6 kerosene lamps locally made out of babyfood tin containers fitted on both sides of the canoes in rows so as to project outside above the upper level of the crafts. Burning torches made of kerosene-soaked cloth tied to edges of poles or thick straps of wornout tyres were also used for this purpose. Fishes so enticed by the light to the surface were caught by employing the type of hooks and line known locally as 'achil' (a nylon main line with 10 to 15 short branch lines each having a hook with artificial bait attached to it).

When a clash between two sections of the people 30 km north of Trivandrum drove many fishermen along with their canoes to the southern part of the district, the fishing fleet in the light-fishing zone was strengthened to about 900 motorised crafts, each intensively carrying out fishing every night until the operation ceased by mid-January when perhaps either the ground was cleared of the stock or the fish driven away to untraceable grounds. The fishing during this period was done at 20 to 30 km from shore at a depth of 85 to 110 m. The catch per unit ranged from 100 to 350 kg. A modest estimate of these catches during the fortnight goes well beyond 2,000 tonnes. The total length of the fish ranged from 205 to 260 mm, with a mean weight of 150 g. The fish were sold at the rate of Rs. 5 to 7 per kg at the landing centres on different days.

A detracting factor related to the fish catch was its kerosene contamination. Evidently, while the fish caught were being dumped into the canoe containing a little quantity of water and drops of kerosene spilled from the engine or the lamps, the fish gasped for breath and in this process the gills seemed to have been clogged with the kerosene droplets. The contamination was to the extent of the flesh exuding an offensive odour and disagreeable taste even after being cooked. This necessitated the merchants to find fresh markets every day, since once having experienced its smell, the consumers naturally avoided it a second time, though it is otherwise a thick-muscled tasty table fish.

After this unusual catch by light-fishing, a similar case of fishing by shore seine has come to light. A high voltage electric search-light, provided at the beach of Valiaveli, a fish landing centre 10 km north of Trivandrum, also attracted the same species of fish to near-shore waters for a period of one month during January–February, 1987. At this centre, 40 to 50 shore-seine operations were made every night with an average catch of 150 kg per unit. The fish was conspicuously absent in the shore seine operations attempted there during day time.

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[*] Prepared by Jacob Jerold Joel, R. Bhaskaran Achari and T. G. Vijaya Warrier, Vizhinjam Research Centre of CMFRI, Vizhinjam.

OCCURRENCE OF MATURE *MUGIL CEPHALUS* ALONG THE CALICUT COAST*

The mature *Mugil cephalus* has been reported from various parts of the country. It has been found along the Orissa and Tamil Nadu coasts. A few specimens have been reported from Mandapam also. But there is no record of its occurrence along the Calicut coast. Hence the observation on the mature *Mugil cephalus* from the Calicut coast is of interest especially in the context of renewed efforts to develop hatchery techniques for the species.

While studying the biology of *Mugil cephalus* to understand its maturation and breeding season along the Calicut coast, a few matured *Mugil cephalus* were collected during June and July 1986. During this period the fish were caught from surf area at Beypore near Chaliyar River and at Elathur near Korapuzha Estuary. A few specimens were obtained from West Hill beach in cast nets.

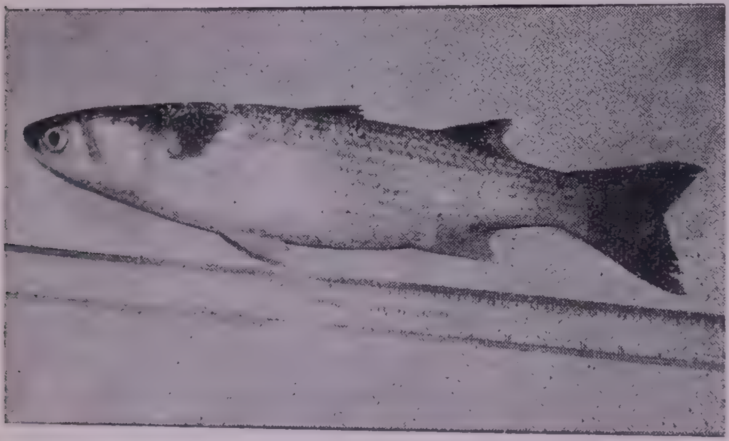

Fig. 1. Mature specimen of *Mugil cephalus* collected from West Hill beach, Calicut. Length 460 mm, wt. 1,120 g.

During the peak monsoon months when the surf water is turbid and cool (around 26°C) the fishermen venture into the surf area during early morning hours (0400-0600 hrs) braving the rain and cold weather. About 20 to 25 fishermen were observed fishing grey mullets near the Chaliyar Estuary at Beypore. The grey mullet locally known as 'Thirutha' is a delicacy especially when they have ripe eggs and each fish weighing bout 1 kg may fetch about Rs. 60 to 70.

The length range of the female fishes was 445 to 460 mm (Fig. 1) weighing 1,000 to 1,200 g. The ovary measured 106 to 165 mm in length and weighed 50 to 207 g. (Fig. 2 & 3). The ova diameter was 0.210 to 0.629 mm and the gonadosomatic index was found to be 4 to 20.

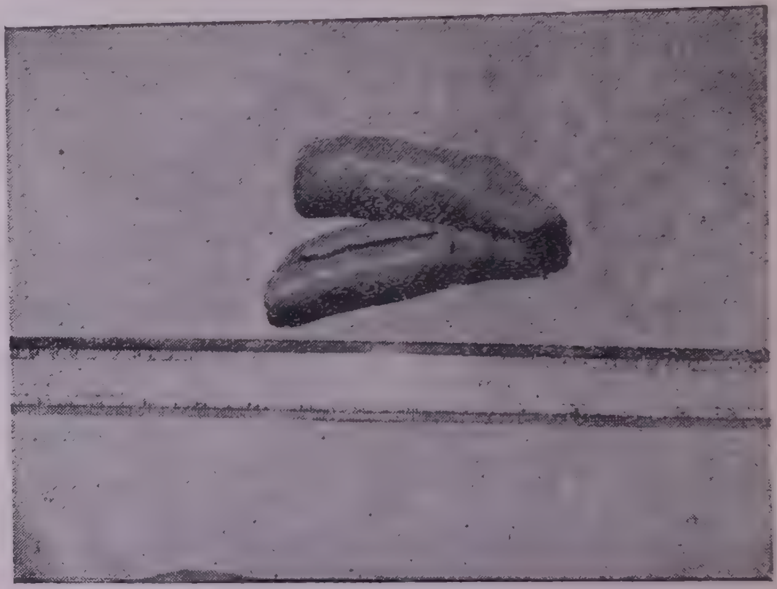

Fig. 2. Matured ovary of length 165 mm, weighing 207 g of *Mugil cephalus* of length 460 mm and wt. 1,120g.

The length of the male specimens ranged from 355-380 mm and weighed 450 to 560 g. The testis measured 40 to 85 mm weighing 6 to 10 g. Motile sperms were observed in the milt collected from the oozing males obtained from the West Hill beach, Calicut from 7-6-1986 to 16-6-1986

The non-availability of matured specimens with required ova diameter is one of the constraint for the development of hatchery for the specimens The specimen with ova diameter of more than 0.6 mm was cited as one which has attained the required ovarian development for hypophysation. Examination of ova from matured specimens collected from Calicut indicated the availability of such suitable female specimens. It may be considered as one of the favourable conditions for development of hatchery at Calicut coast.

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*Prepared by R. S. Lal Mohan and K. Nandakumaran, Calicut Research Centre of CMFRI, Calicut.

HEAVY LANDINGS OF CAT FISH BY 'DOL' NETS AT SASSOON DOCKS *

Fixed bag net locally called 'dol' is one of the traditional gears used by the fishermen of Maharashtra. Sassoon Docks is one of the major landing centres for 'dol' netters. The chief fishes caught by this net include non-penaeid prawns and Bombay duck. In general the operation of 'dol' net at this centre is restricted to about 20 metres of depth and the catch is brought ashore after one or two hauls.

On 20th January, 1987 at about 0700 hrs huge landing of cat fishes was observed from two 'dol' netters at Sassoon Docks. On enquiry, it was learnt that one of them carried the catch from the fishing ground to Sassoon Docks whereas the catch was netted by the other boat. This particular 'dol' netter set out for fishing at about 1800 hours on the previous day and after two hours of steaming, it reached the fishing ground southwest of Bombay at a place near to Khanderi light house situated at about 16 kms away from Sassoon Docks. The net was operated at a depth of about 12 metres.

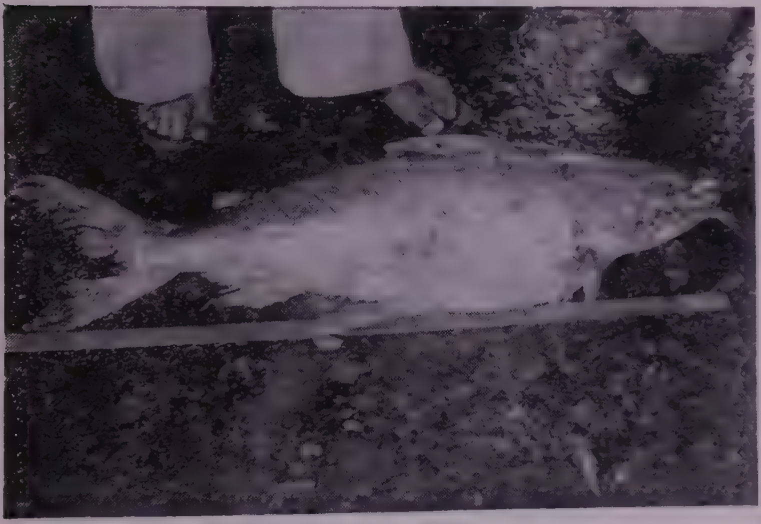

Fig. 1. *Tachysurus dussumieri.*

In one haul lasting about four hours large quantities of cat fishes were caught. As the crew members never expected such a bumper catch they were not adequately prepared to carry the catch to Sassoon Docks. In order to transport it to the landing centre they had to hire another 'dol' netter.

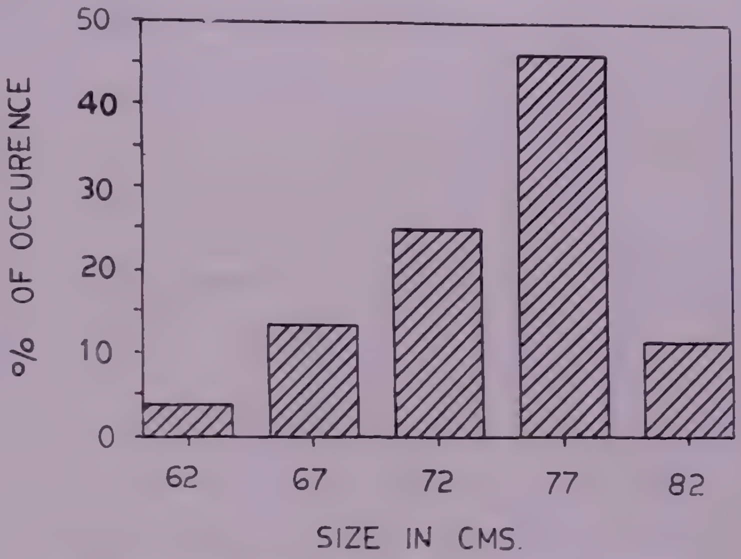

Fig. 2. Size distribution of cat fish, *Tachysurus dussumieri.*

The cat fishes comprised only one species namely *Tachysurus dussumieri.* Total catch during this four hour fishing was 7,655 kg giving a catch per hour of 1,916.25 kg. This boat operated three nets at the fishing ground. Each fish weighed 6 to 9 kg and total number was 1,095. Length measurements were taken for a sample of 52 catfishes and the size ranged from a minimum of 65 to a maximum of 88.5 cm (Fig. 1).

The entire catch was sold by auction at the landing centre itself for a price of Rs. 32,850 at a rate of Rs. 30/- per fish. These fishes were in turn sent to Crawford market, Bombay.

In general cat fishes are rarely caught by 'dol' netters. Annual catch figures from 1983 to 1986 show that cat fishes contributed only two per cent of the 'dol' net catches. This fish is mainly caught by hooks and line and trawlers. Sudden catch of this species by 'dol' net has generated good deal of interest among the fishermen as well as scientists.

The author wishes to record his deep sense of gratitude to Dr. K. Alagaraja and Dr. (Smt.) P.V. Kagwade for the encouragement and valuable suggestions in preparing this note.

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*Prepared by K. B. Waghmare, Bombay Research Centre of CMFRI, Bombay.

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MARINE FISHERIES INFORMATION SERVICE

Technical and Extension Series

No. 79
JANUARY 1988

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

COCHIN, INDIA

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

THE MARINE FISHERIES INFORMATION SERVICE: Technical and Extension Series envisages the rapid dissemination of information on marine and brackish water fishery resources and allied data available with the National Marine Living Resources Data Centre (NMLRDC) and the Research Divisions of the Institute, results of proven researches for transfer of technology to the fish farmers and industry and of other relevant information needed for Research and Development efforts in the marine fisheries sector.

Abbreviation – *Mar. Fish. Infor. Serv., T & E Ser.,* No. **79**: 1988

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4. A record catch of 'Ghol' *Protonibea diacanthus* (Lacepede) off Satpati, Bombay Coast

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Front cover photo:

A purse seiner fishing off Mangalore.

Back cover photo:

Malpe Fisheries Harbour, Malpe (South Kanara).

PREFACE

Central Marine Fisheries Research Institute, Cochin and its Research Centres at Veraval, Bombay, Karwar, Mangalore, Calicut, Vizhinjam, Tuticorin, Mandapam, Madras, Kakinada, Visakhapatnam and Minicoy conduct short-term and long-term multidisciplinary researches on the marine capture and culture fisheries of the country. This is to provide research support for the rational exploitation, conservation and management of the marine fishery resources and for stepping up fish production from the seas around the country.

Often enquiries are received from industrialists and entrepreneurs regarding the seasonal availability, abundance, size, spawning seasons, vulnerability to various gears *etc.* of many commercially important species of marine fishes. Currently such information are either improperly documented or not readily available to the end users; the fishermen, entrepreneurs and government departments. In order to fill up this lacuna in our knowledge, it is planned to bring out a series of fish calendars which would contain vital fishery information such as annual average catch of each fish group and its percentage in total fish catch, major fishing methods and the percentage contributions of each species in the gears, availability during different season, vulnerability to various gears, length range in the commercial fishery, depth of distribution, size at first maturity, spawning seasons *etc.* of almost all commercially important species of fishes of any given centre. Gear-wise seasonal abundance of families is shown as kite diagrams based on a five year data for the 1981–'85 period and the species composition in each gear is given in histograms.

It is to be noted that all the fish species landed at any identified centre may not find a place in the fish calendars due to lack of full and detailed information, but attempts have been made to include as many commercially important species as possible. The families are not arranged in the taxonomic order. Instead, they are listed in the alphabetic order to make it easy for the end user.

The present issue for the Mangalore Research Centre is the first in the series of fish calendars from the 12 research centres of the Institute. The calendars for the other centres will be published in the forthcoming issues of Marine Fisheries Information Service, Technical and Extension Series.

Several scientists and technical staff of the Institute have put in a lot of effort in the preparation of these calendars. I wish to record here my appreciation to all of them.

P. S. B. R. JAMES
Director,
Central Marine Fisheries
Research Institute,
Cochin - 682 031.

MARINE FISH CALENDAR

1. MANGALORE*

K.V. Narayana Rao, C. Muthiah and Madan Mohan

Mangalore Research Centre of CMFRI, Mangalore

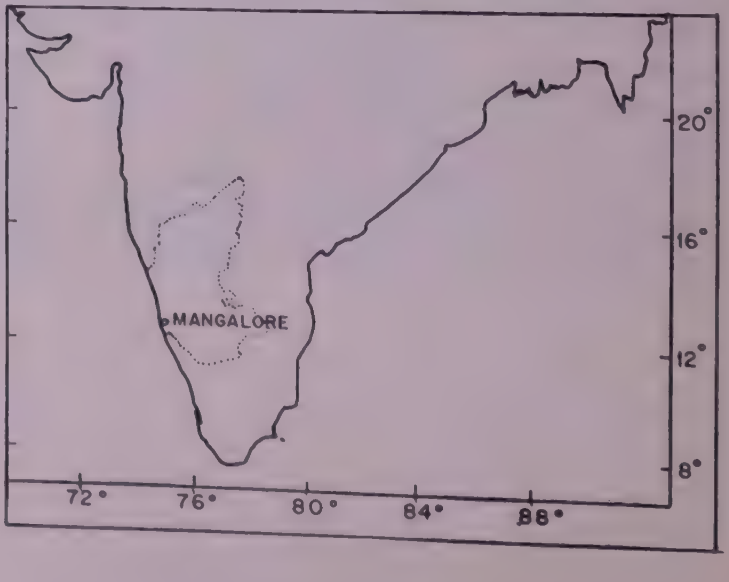
Introduction

Mangalore, one of the major fish landing centres of Karnataka, produces annually 43,559 t of fish forming about 33% of the state's marine fish landings. Prior to early seventies the principal gears employed in the fishery were shrimp trawls and indigenous gears *viz.*, 'Rampani', small shore seines, cast nets and gill nets. In the late seventies, the fishing pattern underwent a major change with the introduction of purse seine, augmenting fleet strength of shrimp trawls and mechanisation of gill net crafts. Of the present average annual production (1981–'85) at Mangalore, the purse seiners account for the bulk of the catch, with 33,850 t which forms 78% of the total all fish catch followed by shrimp trawlers with 9,302 t (21%) and gill netters 407 t (1%).

Fishing operations are carried out within 50 m depth between Kaup in the north (45 km) and Kasaragod in the south (40 km). During the peak season (Sep.–Jan.) fishing by purse seines for major pelagics is conducted around 10–20 m depth with extension upto 35 m depth in other months. The area within 15 km from the shore, forms the trawling ground for demersal fishes and crustaceans. The area between 15 and 45 m depth provides the fishing ground for drift gill netters for larger pelagics.

The fishing season commences in September (at the end of the southwest monsoon) and extends upto the end of May (the beginning of southwest monsoon). The peak period of production by purse seiners is from September–December when about 76% of the annual catch by this gear is obtained. The average monthly catch for the above period is 6,462 t. The peak month is October contributing 8,760 t which is equal to 26% of the annual catch. The catch slides down from December and the average monthly catch during the lean season (January–May) is 1,588 t. For trawlers, best season is during January–April which produces 72% of the annual trawl catch with a monthly average catch of 2,413 t. Maximum production takes place in March forming 30% (2,862 t) of the annual catch. Decline in production starts from May touching the lowest in September–November and an upward trend is seen from December onwards. Drift gill netters have productive period in September–January with an average monthly catch of 76 t. About 93% of the annual drift net catch is realised during this period. The highest landings are in October and November with an estimated catch of 123 and 125 t respectively. The landings decline from February to May; the monthly average catch during this lean season being 7 t. The period from June to August is a closed season when no fishing is done.

By and large, the fish landings in the Mangalore region are dominated by pelagics forming 75%. Demersal varieties contribute 25%. The predominant species/



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*Consolidated by N. Gopinatha Menon and K. Balachandran, CMFRI, Cochin.

groups among the pelagic component are oil sardine (forming 44.3% of the total marine fish catch), mackerel (10.5%), anchovies (8.4%), carangids (4.0%), tuna (2.3%), lesser sardines (2.0%), cat fishes (5.3%), threadfin breams (2.3%), soles (2.0%), lizard fishes (1.0%) and silver bellies (1.0%) in the demersal component.

For the preparation of this 'Fish Calendar', fish landing data of purse seiners and drift gill netters collected by this Research Centre from 1981 to '85 and trawls from 1986 to '87 have been utilised for gear-wise species composition and seasonal abundance studies. However, in the case of trawls, the annual fish landing data for the Mangalore Centre for the periods 1983–'84 and 1984–'85 have been considered for annual average catch studies of individual species/group.

It should, however, be stressed here that the account on fish calendar outlined here is not exhaustive, and it needs to be updated as and when more information are available especially with regard to demersal fisheries.

CARANGIDAE

Popular English Name : Trevallies/Horse mackerels/Scads

Vernacular Name (Kannada) : 'Bathi'/'Thakatte'/'Kodande'/'Tidema'/'Melagu meenu' / 'Palai meenu'

Annual average catch : 1,745.3 t.

Gear wise annual average catch :
- Purse seine : 1,210.48 t
- Trawl net : 529.48 t
- Drift gill net : 5.32 t

Fishing methods and their contribution in total catch :
- Purse seine : 3.6%
- Trawl net : 5.7%
- Drift gill net : 1.3%

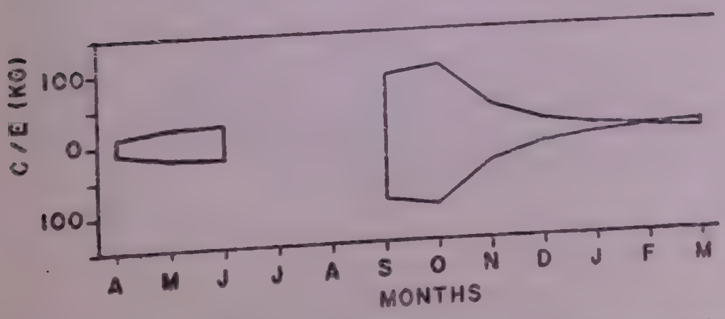

Fig. 1. Seasonal abundance of carangids in the purse seining grounds off Mangalore.

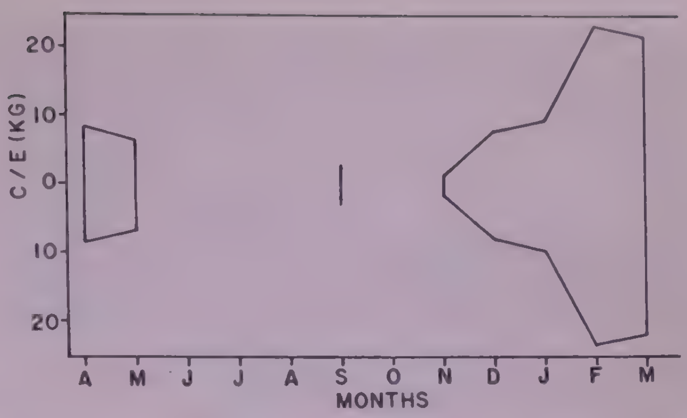

Fig. 2. Seasonal abundance of carangids in the trawling grounds off Mangalore.

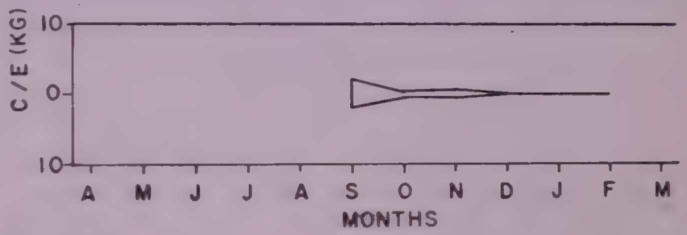

Fig. 3. Seasonal abundance of carangids in the drift gill netting grounds off Mangalore.

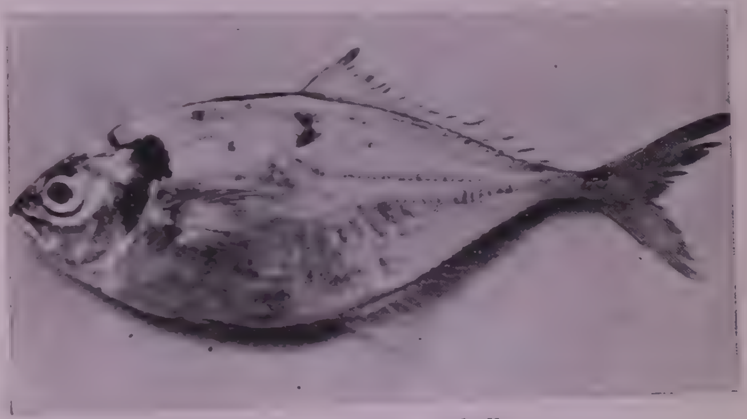

Fig. 4. *Caranx kalla.*

Scientific Name : *Caranx kalla*

Vernacular Name : 'Bathi'

Gear : Purse seine/Trawl net/Drift gill net

Peak period of occurrence : Sep.–Nov./Jan. –Mar.

Depth of occurrence : 4–50 m

Length range in commercial fishery : 90–165 mm

Size at first maturity : 124 mm

Spawning season : Dec.–Jan./May–Jun.

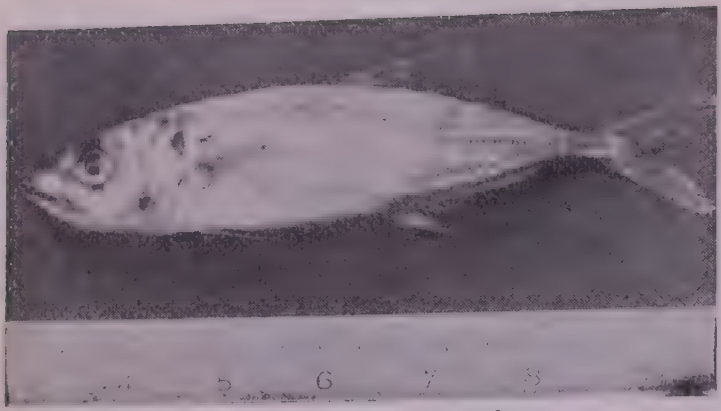

Fig. 5. *Decapterus kurroides.*

Scientific Name	:	*Decapterus kurroides*
Vernacular Name	:	'Tidema'
Gear	:	Purse seine/Trawl net
Peak period of occurrence	:	Sep.–Nov./Jan.–Mar.
Depth of occurrence	:	4–50 m
Length range in commercial fishery	:	—
Size at first maturity	:	—
Spawning season	:	—

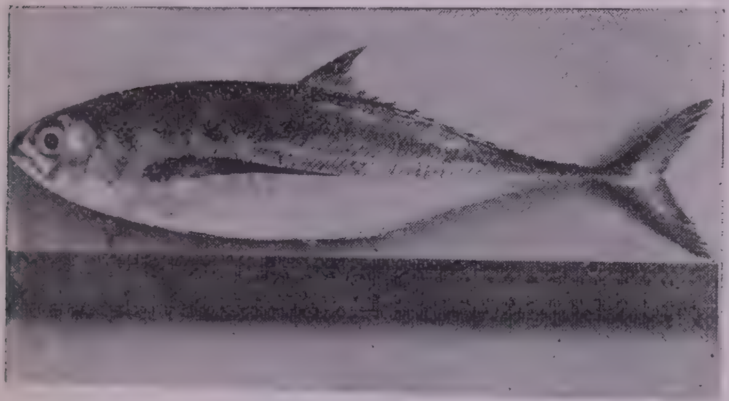

Fig. 6. *Megalaspis cordyla.*

Scientific Name	:	*Megalaspis cordyla*
Vernacular Name	:	'Kodande'
Gear	:	Purse seine/Drift gill net
Peak period of occurrence	:	September–November
Depth of occurrence	:	15–45 m
Length range in commercial fishery	:	—
Size at first maturity	:	—
Spawning season	:	—

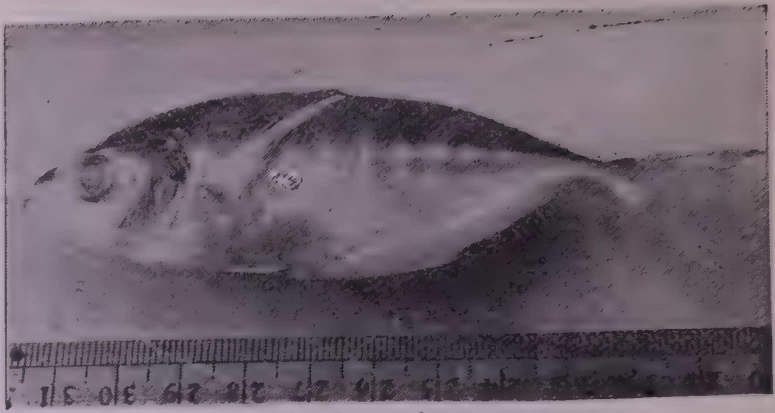

Fig. 7. *Atule mate.*

Scientific Name	:	*Atule mate*
Vernacular Name	:	'Thakatte'
Gear	:	Trawl net
Peak period of occurrence	:	January–March
Depth of occurrence	:	4–50 m
Length range in commercial fishery	:	—
Size at first maturity	:	—
Spawning season	:	—

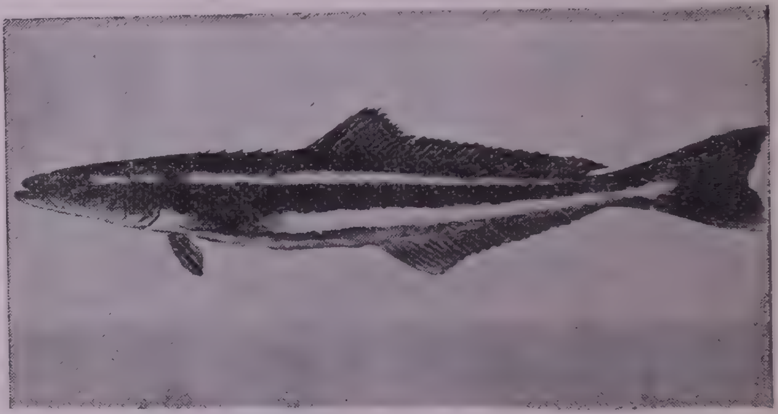

Fig. 8. *Elacate niger.*

Scientific Name	:	*Elacate niger*
Vernacular Name	:	'Melagu meenu'
Gear	:	Drift gill net
Peak period of occurrence	:	October–November
Depth of occurrence	:	18–45 m
Length range in commercial fishery	:	—
Size at first maturity	:	—
Spawning season	:	—

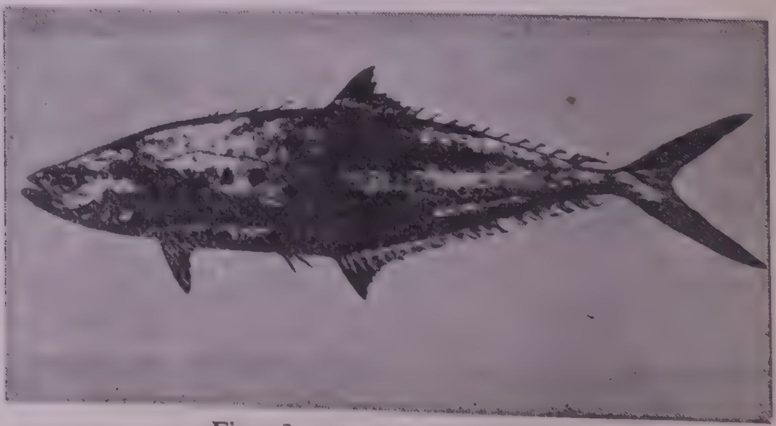

Fig. 9. *Chorinemus lysan.*

Scientific Name : *Chorinemus lysan*
Vernacular Name : 'Palai meenu'
Gear : Drift gill net
Peak period of occurrence : October–November
Depth of occurrence : 18–45 m
Length range in commercial fishery : —
Size at first maturity : —
Spawning season : —

Carcharhinidae and Sphyrnidae

Popular English Name : Sharks and Hammer-head sharks
Vernacular Name (Kannada) : 'Thate'/'Kebi thate'
Annual average catch : 119.5 t
Gear wise annual average catch : Purse seine : 1.88 t
Trawl net : 48.79 t
Drift gill net : 68.84 t
Fishing methods and their contribution in total catch : Drift gill net : 16.9%
Trawl net : 0.5%
Purse seine : 0.1%

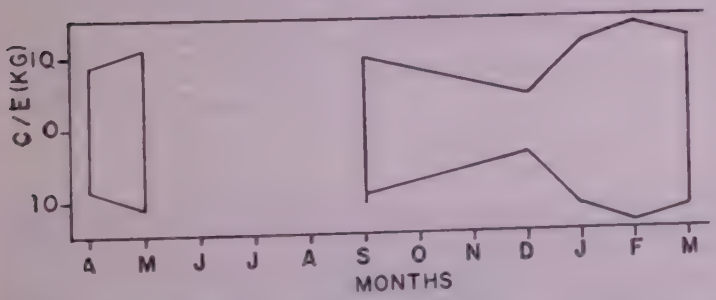

Fig. 10. Seasonal abundance of sharks in the drift gill netting grounds off Mangalore.

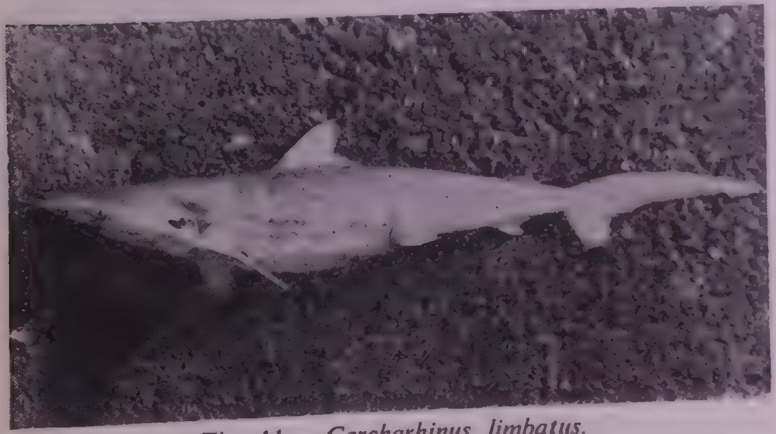

Fig. 11. *Carcharhinus limbatus.*

Scientific Name : *Carcharhinus limbatus*
Vernacular Name : 'Kappukedi'/'Thate'
Gear : Purse seine/Drift gill net
Peak period of occurrence : September–February
Depth of occurrence : 15–35 m
Length range in commercial fishery : 420–600 mm
Size at first maturity : 610 mm
Spawning season : —

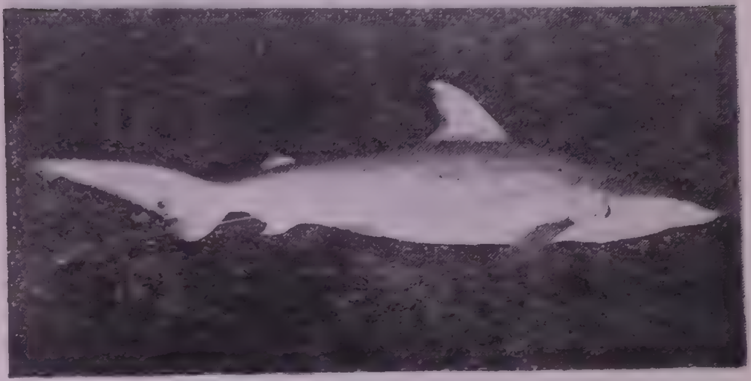

Fig. 12. *Scoliodon laticaudus.*

Scientific Name : *Scoliodon laticaudus*
Vernacular Name : 'Thate'
Gear : Trawl net/Drift gill net
Peak period of occurrence : October–March
Depth of occurrence : 4–50 m
Length range in commercial fishery : 260–320 mm
Size at first maturity : 310 mm
Spawning season : Mar. and Sep.-Dec.

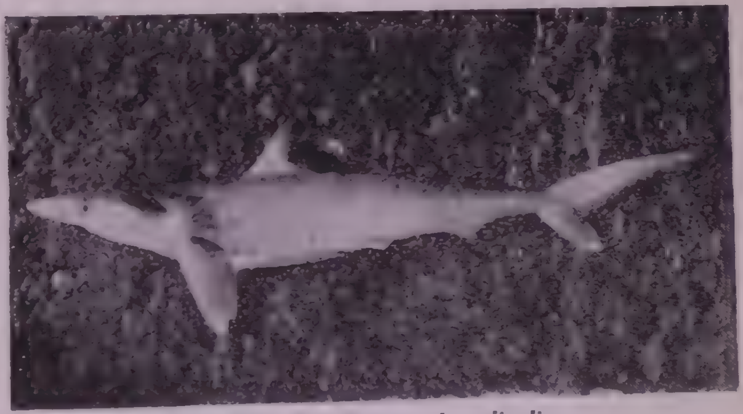

Fig. 13. *Rhizoprionodon oligolinx.*

Scientific Name : *Rhizoprionodon oligolinx*
Vernacular Name : 'Thate'
Gear : Drift gill net/Trawl net
Peak period of occurrence : October–March
Depth of occurrence : 4–50 m
Length range in commercial fishery : 240–450 mm
Size at first maturity : —
Spawning season : —

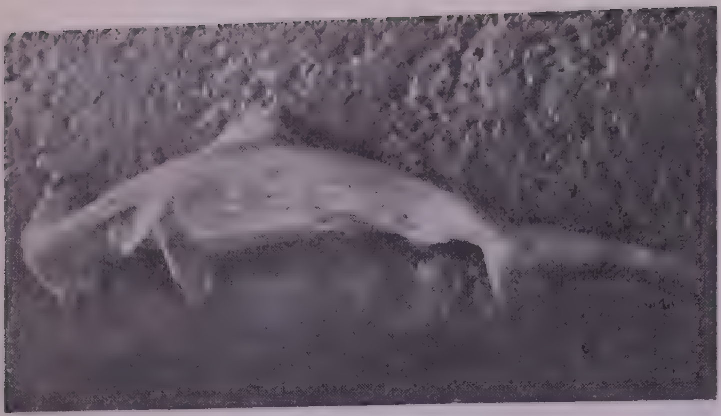

Fig. 14. *Sphyrna lewini.*

Scientific Name : *Sphyrna lewini*
Vernacular Name : 'Kebi thate'
Gear : Drift gill net
Peak period of occurrence : October–February
Depth of occurrence : 18–35 m
Length range in commercial fishery : —
Size at first maturity : —
Spawning season : —

CHIROCENTRIDAE

Popular English Name : Wolf herrings
Vernacular Name (Kannada) : 'Karli'
Annual average catch : 14.8 t
Gear wise annual average catch : Trawl net : 5.80 t
Drift gill net : 6.02 t
Fishing methods and their contribution in total catch : Drift gill net : 1.5%
Trawl net : 0.1%

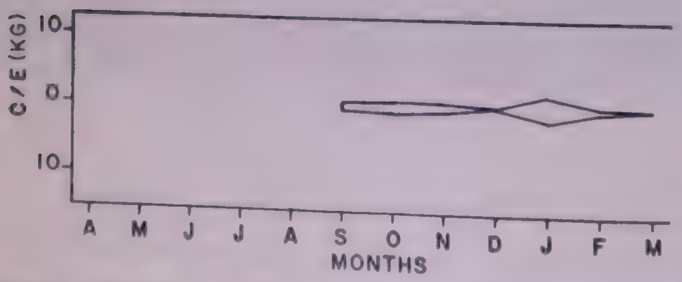

Fig. 15. Seasonal abundance of Wolf-herrings in the drift gill netting grounds off Mangalore.

Scientific Name : *Chirocentrus nudus*
Vernacular Name : 'Karli'
Gear : Drift net/Trawl net
Peak period of occurrence : Jan.–Feb. and Oct.–Nov.
Depth of occurrence : 4–50 m
Length range in commercial fishery : —
Size at first maturity : —
Spawning season : —

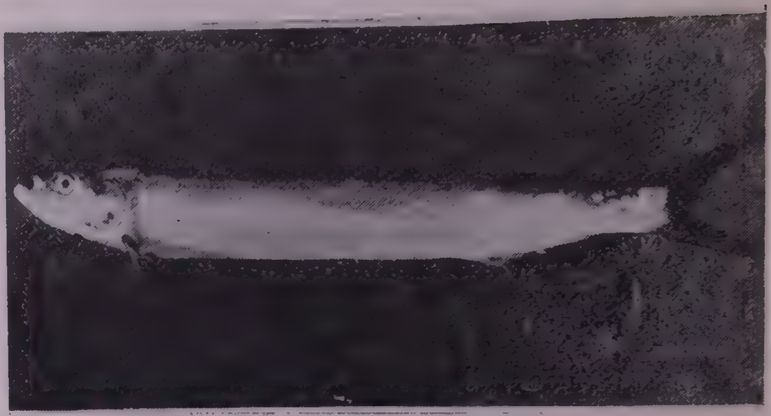

Fig. 16. *Chirocentrus nudus.*

CLUPEIDAE

Popular English Name : Sardines/Shads
Vernacular Name (Kannada) : 'Buthai'/'Erabai'/'Seriande'/'Swadi'
Annual average catch : 20,385.0 t
Gear wise annual average catch : Purse seine : 20,337.64 t
Trawl net : 47.36 t
Fishing methods and their contribution in total catch : Purse seine : 60.1%
Trawl net : 0.5%

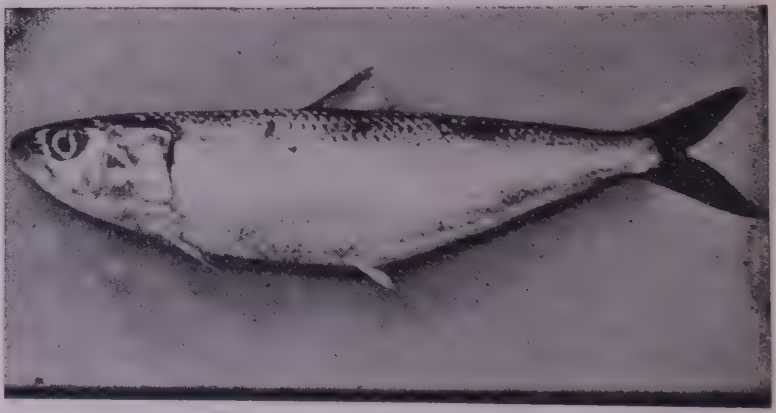

Fig. 17. *Sardinella longiceps.*

Scientific Name : *Sardinella longiceps*
Vernacular Name : 'Buthai'
Gear : Purse seine
Peak period of occurrence : September–February
Depth of occurrence : 20–35 m
Length range in commercial fishery : 100–160 mm
Size at first maturity : 150 mm
Spawning season : June–August

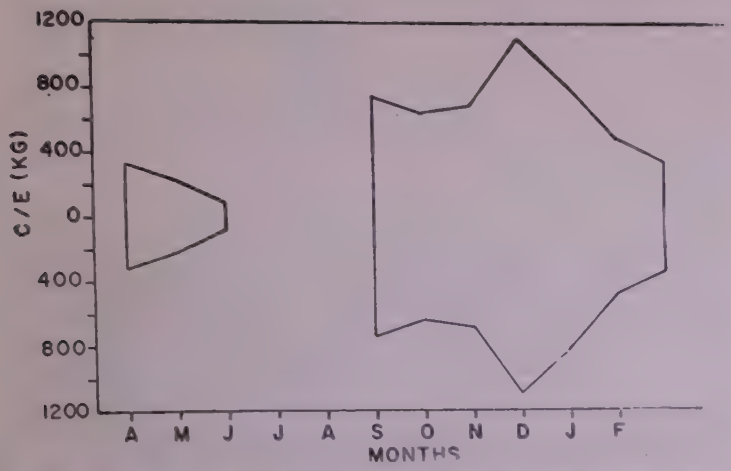

Fig. 18. Seasonal abundance of oil sardine in the purse seining grounds off Mangalore.

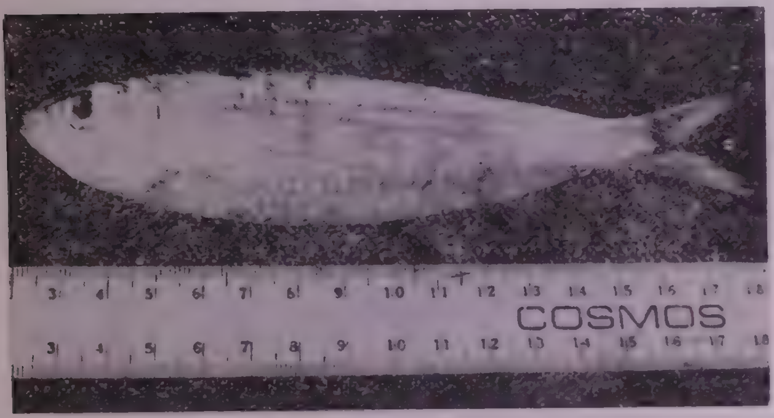

Fig. 19. *Sardinella gibbosa*.

Scientific Name	:	*Sardinella gibbosa*
Vernacular Name	:	'Erabai'
Gear	:	Purse seine
Peak period of occurrence	:	October–March
Depth of occurrence	:	20–35 m
Length range in commercial fishery	:	145–170 mm
Size at first maturity	:	150 mm
Spawning season	:	October–March

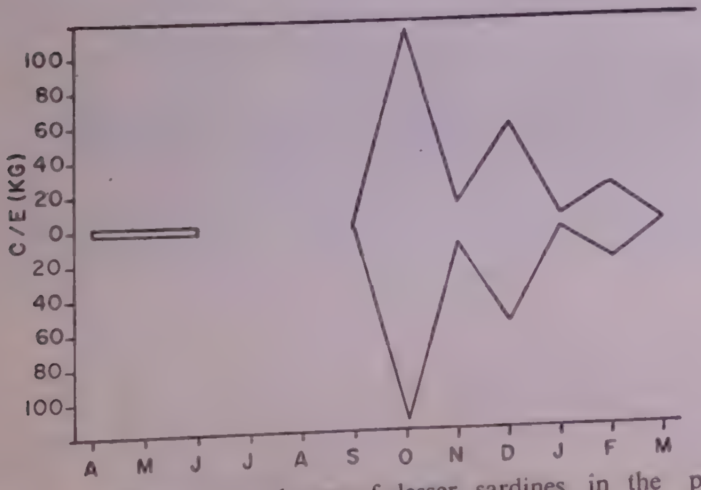

Fig. 20. Seasonal abundance of lesser sardines in the purse seining grounds off Mangalore.

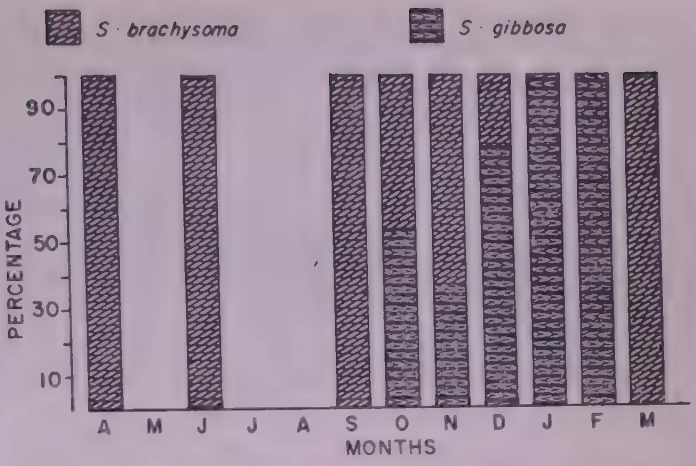

Fig. 21. Month-wise species composition of lesser sardines landed by purse seiners.

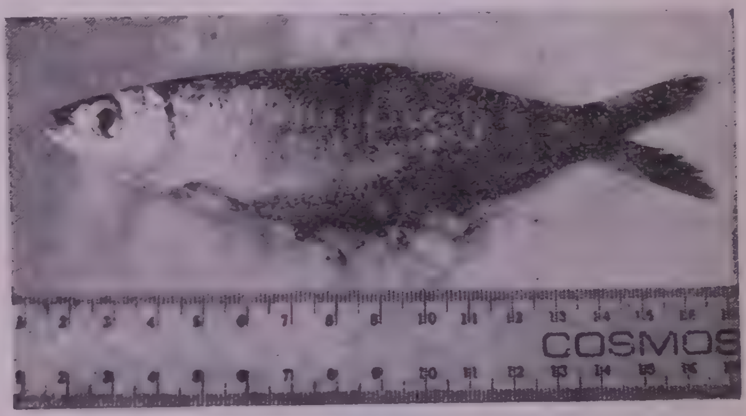

Fig. 22. *Dussumieria acuta*.

Scientific Name	:	*Dussumieria acuta*
Vernacular Name	:	'Seriande'
Gear	:	Purse seine
Peak period of occurrence	:	September–December
Depth of occurrence	:	20–35 m
Length range in commercial fishery	:	—
Size at first maturity	:	—
Spawning season	:	—

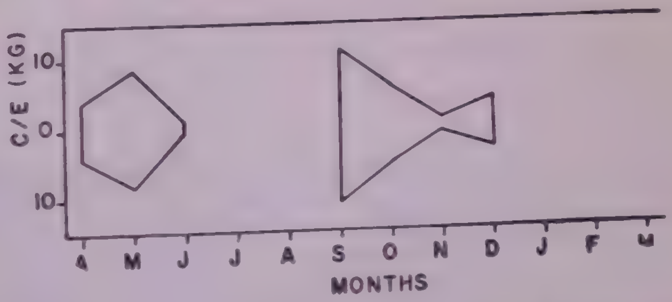

Fig. 23. Seasonal abundance of rainbow sardines in the purse seining grounds off Mangalore.

Scientific Name	:	*Ilisha melastoma*
Vernacular Name	:	'Swadi maikannu'
Gear	:	Trawl net
Peak period of occurrence	:	February–March

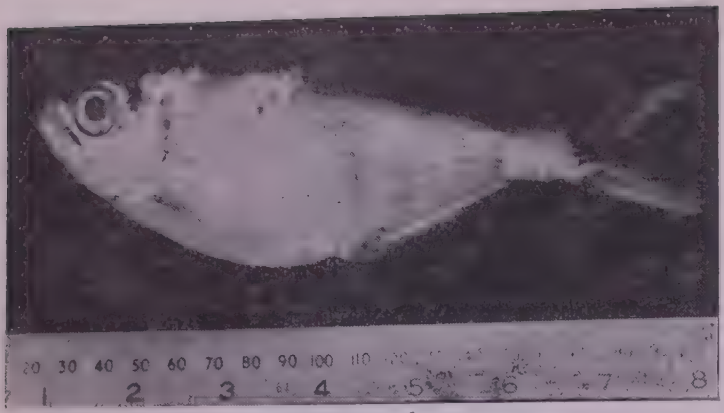

Fig. 24. *Ilisha melastoma.*

Depth of occurrence : 4–50 m
Length range in commercial fishery : —
Size at first maturity : —
Spawning season : —

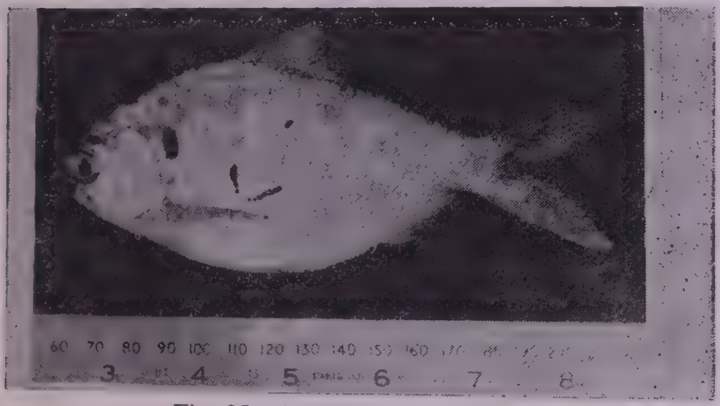

Fig. 25. *Anodontostoma chacunda.*

Scientific Name : *Anodontostoma chacunda*
Vernacular Name : 'Kurandodi swadi'
Gear : Trawl net
Peak period of occurrence : February–March
Depth of occurrence : 4–50 m
Length range in commercial fishery : 145–179 mm
Size at first maturity : —
Spawning season : November–March

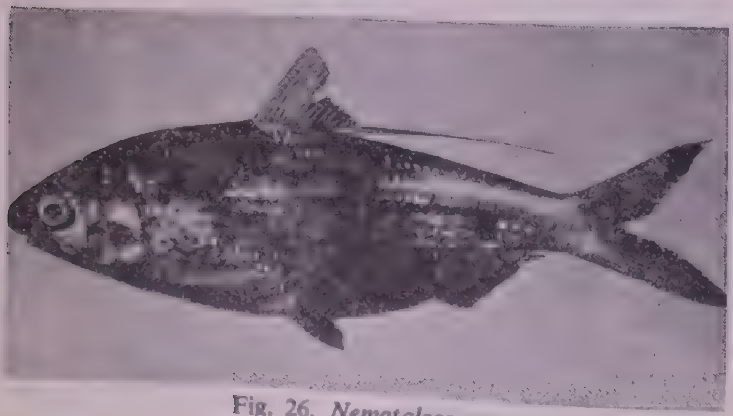

Fig. 26. *Nematalosa nasus.*

Scientific Name : *Nematalosa nasus*
Vernacular Name : 'Hole swadi'
Gear : Trawl net
Peak period of occurrence : February–March
Depth of occurrence : 4–50 m
Length range in commercial fishery : 103–320 mm
Size at first maturity : —
Spawning season : October–November

CYNOGLOSSIDAE

Popular English Name : Tongue soles
Vernacular Name (Kannada) : 'Nangu'
Annual average catch : 839 t
Gear wise annual average catch : Purse seine : 8.20 t
Trawl net : 830.84 t
Fishing methods and their contribution in total catch : Trawl net : 8.9%
Purse seine : 0.1%

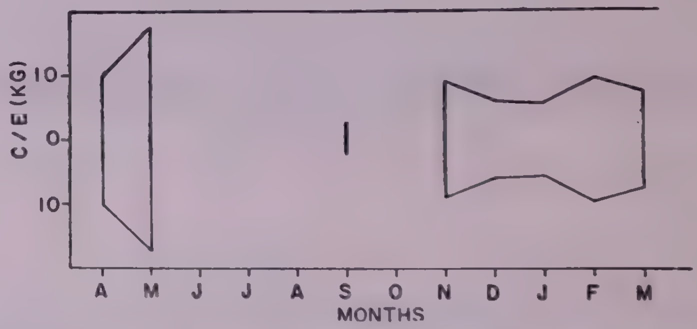

Fig. 27. Seasonal abundance of tongue soles in the trawling grounds off Mangalore.

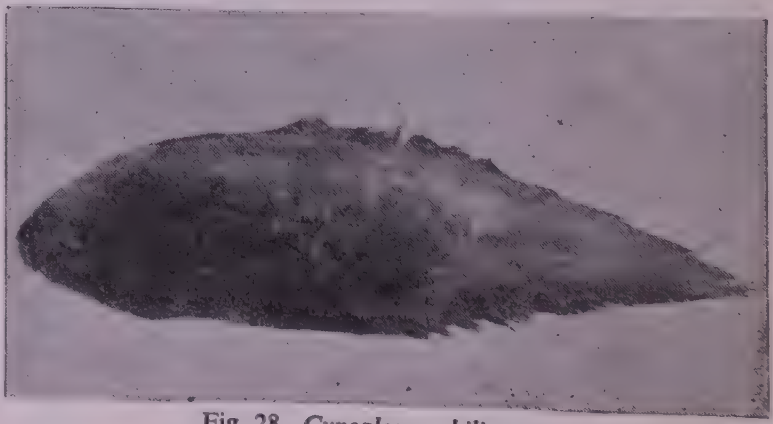

Fig. 28. *Cynoglossus bilineatus.*

Scientific Name : *Cynoglossus bilineatus*
Vernacular Name : 'Nangu'
Gear : Purse seine
Peak period of occurrence : September

Depth of occurrence : 15–35 m
Length range in commercial fishery : —
Size at first maturity : —
Spawning season : —

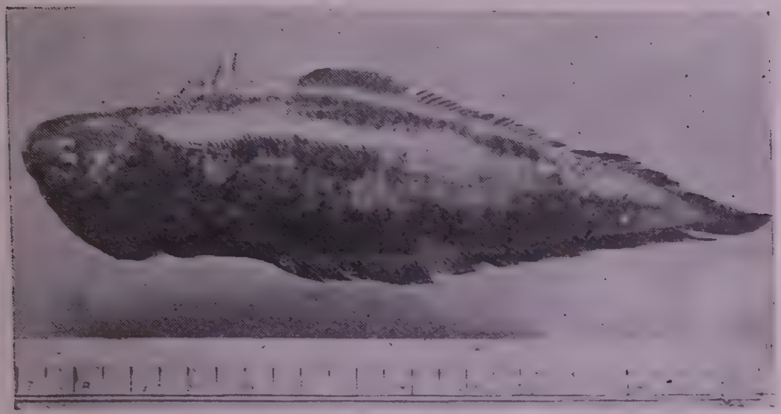

Fig. 29. *Cynoglossus macrostomus.*

Scientific Name : *Cynoglossus macrostomus*
Vernacular Name : 'Nangu'
Gear : Trawl net/Purse seine
Peak period of occurrence : August–September
Depth of occurrence : 4–50 m
Length range in commercial fishery : 100–130 mm
Size at first maturity : 110 mm
Spawning season : October–January

ENGRAULIDAE

Popular English Name : Anchovies
Vernacular Name (Kannada) : 'Kollatharu'/'Manangu'
Annual average catch : 3,792.7 t
Gear wise annual average catch : Purse seine : 3,661.96 t
Trawl net : 130.87 t
Fishing methods and their contribution in total catch : Purse seine : 10.8 %
Trawl net : 1.4 %

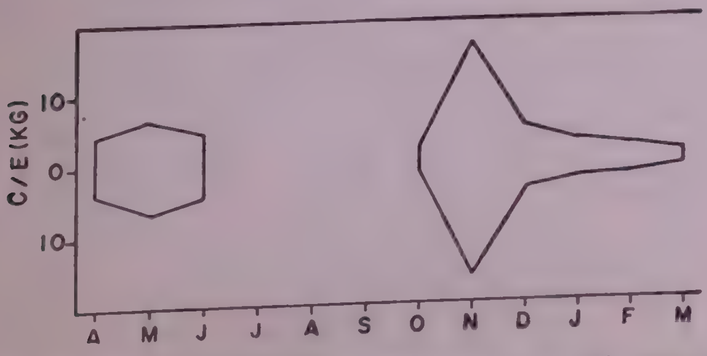

Fig. 30. Seasonal abundance of anchovies in the trawling grounds off Mangalore.

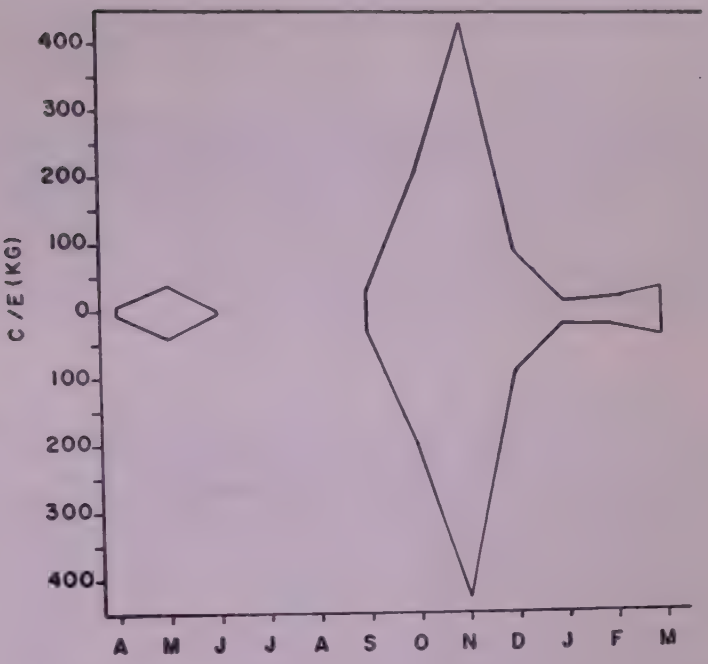

Fig. 31. Seasonal abundance of anchovies in the purse seining grounds off Mangalore.

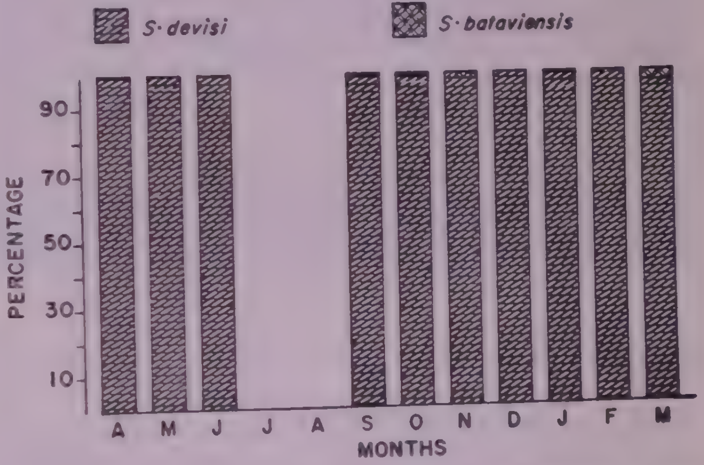

Fig. 32. Month-wise species composition of anchovies landed by purse seiners.

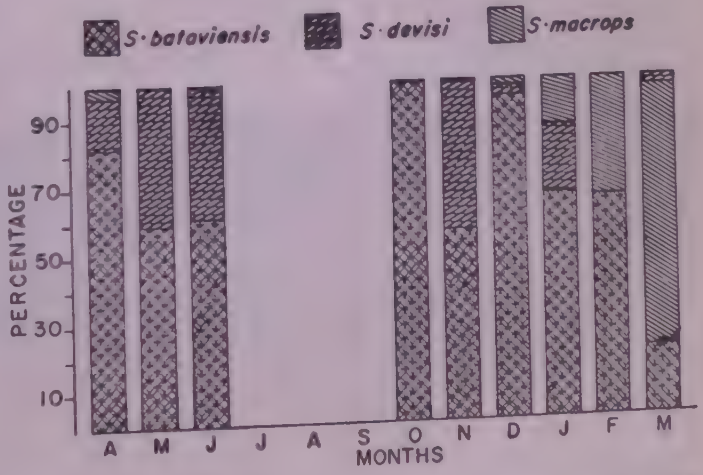

Fig. 33. Month-wise species composition of anchovies landed by shrimp trawlers.

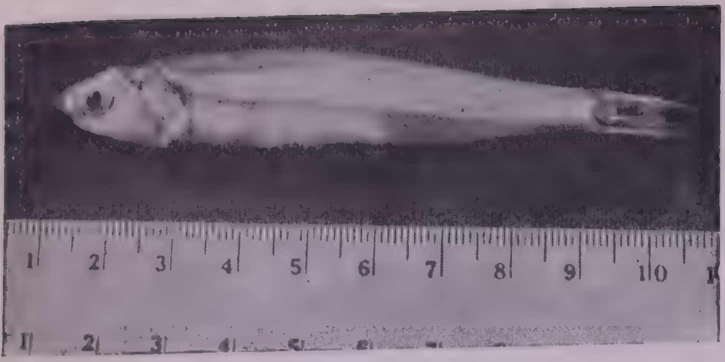

Fig. 34. *Stolephorus devisi.*

Scientific Name : *Stolephorus devisi*
Vernacular Name : 'Kollatharu'
Gear : Purse seine/Trawl net
Peak period of occurrence : Oct.–Dec. and Apr.–May
Depth of occurrence : 4-50 m
Length range in commercial fishery : 70–94 mm
Size at first maturity : 75 mm
Spawning season : Apr.–May and Oct.–Dec.

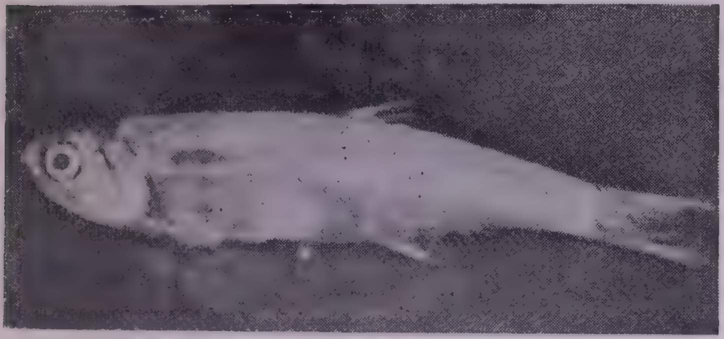

Fig. 35. *Stolephorus bataviensis.*

Scientific Name : *Stolephorus bataviensis*
Vernacular Name : 'Kollatharu'
Gear : Purse seine/Trawl net
Peak period of occurrence : November–December
Depth of occurrence : 4–50 m
Length range in commercial fishery : 79–95 mm
Size at first maturity : 85 mm
Spawning season : Apr.–May and Oct.–Dec.

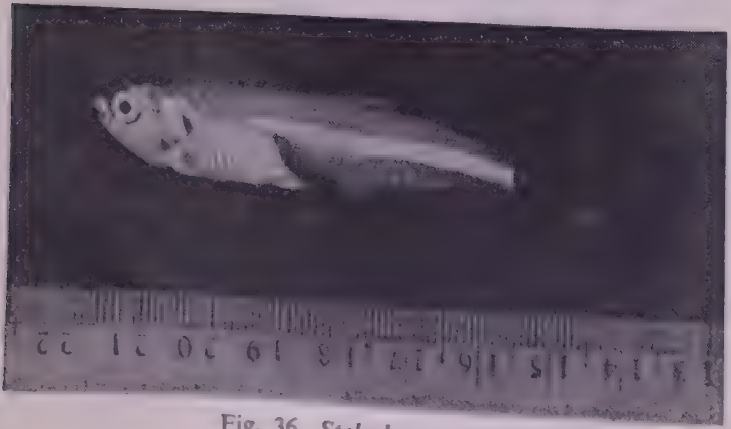

Fig. 36. *Stolephorus macrops.*

Scientific Name : *Stolephorus macrops*
Vernacular Name : 'Kollatharu'
Gear : Purse seine/Trawl net
Peak period of occurrence : Feb.–Mar. and Nov.
Depth of occurrence : 4–50 m
Length range in commercial fishery : 65–74 mm
Size at first maturity : 70 mm
Spawning season : —

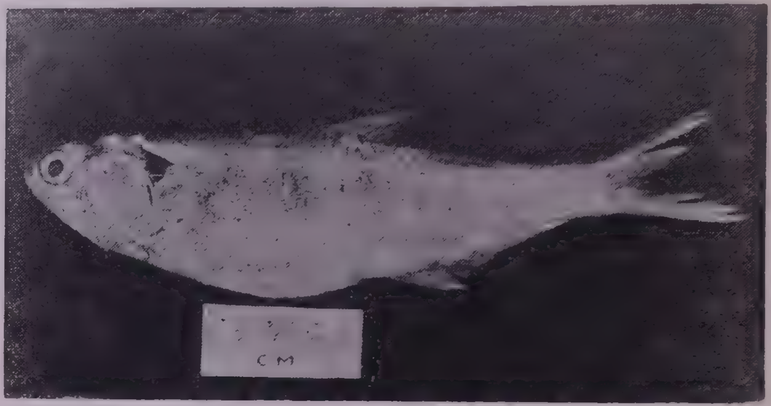

Fig. 37. *Thryssa mystax.*

Scientific Name : *Thryssa mystax*
Vernacular Name : 'Manangu'
Gear : Purse seine/Trawl net
Peak period of occurrence : Sept.–Oct. and Jan. Mar.

Depth of occurrence : 4–50 m
Length range in commercial fishery : —
Size at first maturity : 140 mm
Spawning season : Jan.–Mar. and Jun.–Jul.

LACTARIIDAE

Popular English Name : Big-jawed jumper
Vernacular Name (Kannada) : 'Ade meenu'
Annual average catch : 157.8 t
Gear wise annual average catch : Trawl net : 157.8 t
Fishing methods and their contribution in total catch : Trawl net : 1.7%

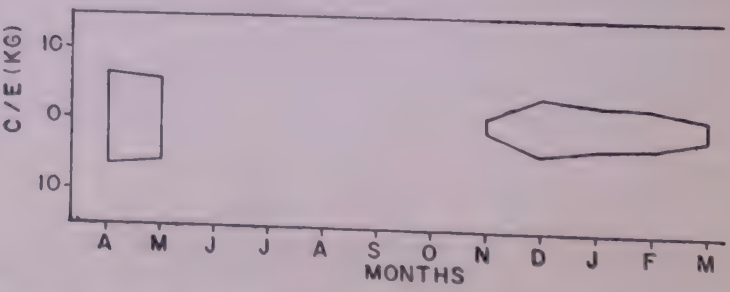

Fig. 38. Seasonal abundance of big-jawed jumper in the trawling grounds off Mangalore.

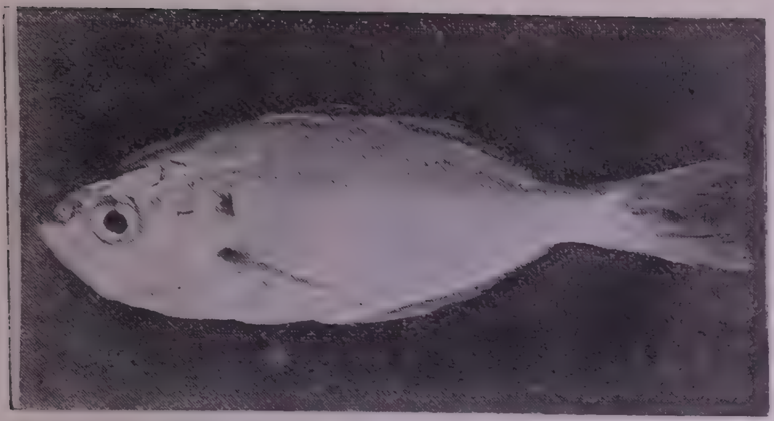

Fig. 39. *Lactarius lactarius.*

Scientific Name : *Lactarius lactarius*
Vernacular Name : 'Ade meenu'
Gear : Trawl net
Peak period of occurrence : January–May
Depth of occurrence : 4–50 m
Length range in commercial fishery : —
Size at first maturity : 167 mm
Spawning season : February–April

LEIOGNATHIDAE

Popular English Name : Silver bellies
Vernacular Name (Kannada) : 'Kurchi'
Annual average catch : 442.8 t
Gear wise annual average catch : Purse seine : 322.82 t
Trawl net : 120.01 t

Fishing methods and their contribution in total catch : Purse seine : 1.0%
Trawl net : 1.3%

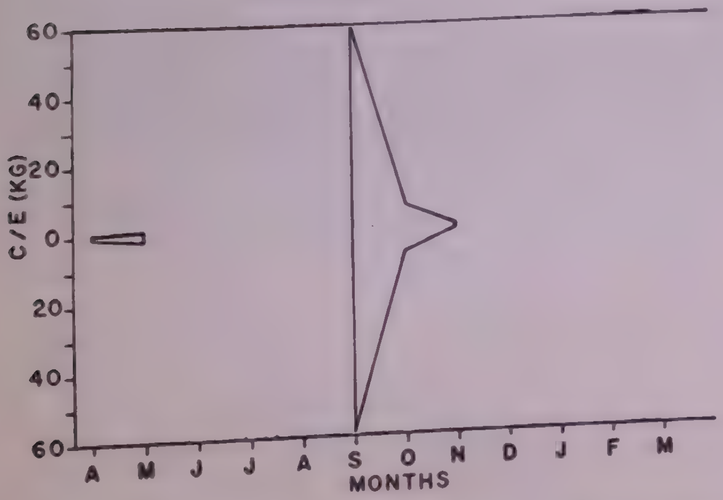

Fig. 40. Seasonal abundance of silver bellies in the purse seining grounds off Mangalore.

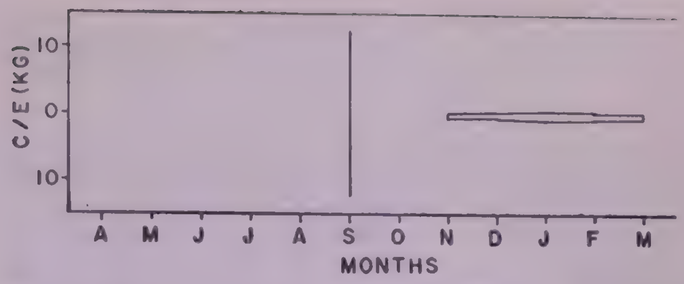

Fig. 41. ,Seasonal abundance of silver bellies in the trawling grounds off Mangalore.

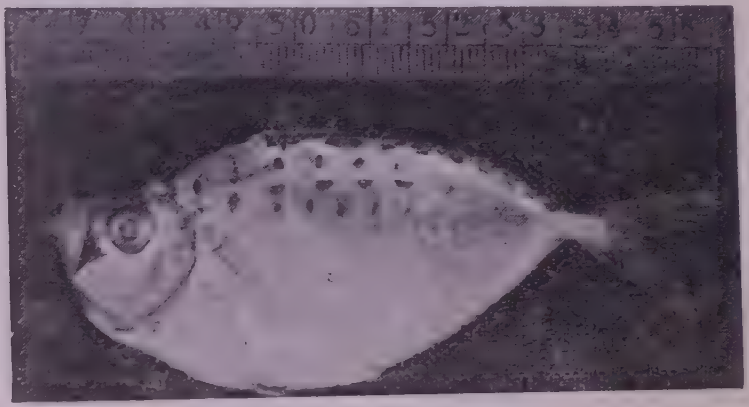

Fig. 42. *Secutor insidiator.*

Scientific Name : *Secutor insidiator*
Vernacular Name : 'Kurchi'
Gear : Purse seine
Peak period of occurrence : September
Depth of occurrence : 15–35 m
Length range in commercial fishery : —
Size at first maturity : 81 mm
Spawning season : Jul.–Nov. and Mar. –Apr.

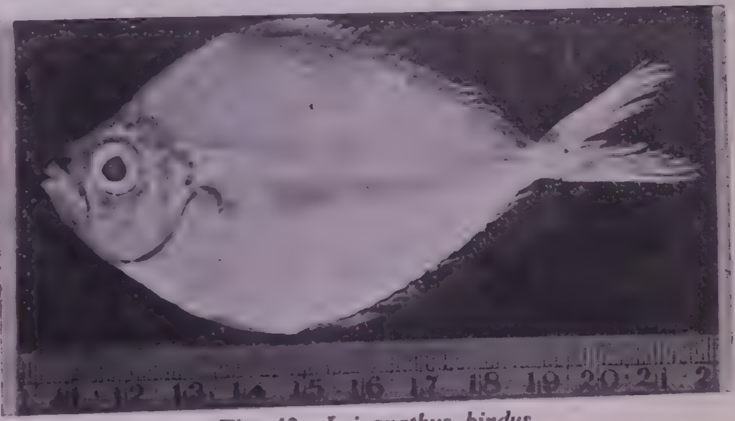

Fig. 43. *Leiognathus bindus.*

Scientific Name : *Leiognathus bindus*
Vernacular Name : 'Kurchi'
Gear : Purse seine
Peak period of occurrence : September
Depth of occurrence : 15–35 m
Length range in commercial fishery : —

Size at first maturity : 85 mm
Spawning season : December–February

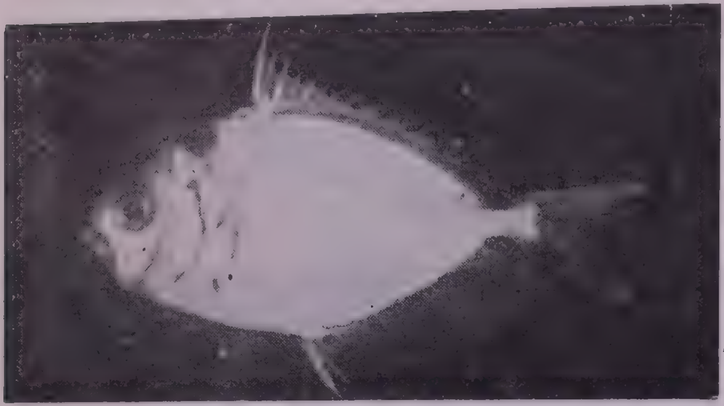

Fig. 44. *Leiognathus brevirostris.*

Scientific Name : *Leiognathus brevirostris*
Vernacular Name : 'Kurchi'
Gear : Purse seine
Peak period of occurrence : September
Depth of occurrence : 15–35 m
Length range in commercial fishery : —
Size at first maturity : —
Spawning season : —

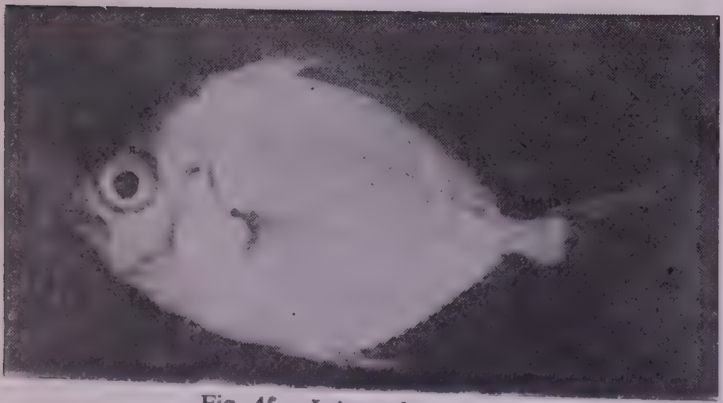

Fig. 45. *Leiognathus splendens.*

Scientific Name : *Leiognathus splendens*
Vernacular Name : 'Kurchi'
Gear : Purse seine
Peak period of occurrence : September
Depth of occurrence : 15–35 m
Length range in commercial fishery : —
Size at first maturity : —
Spawning season : —

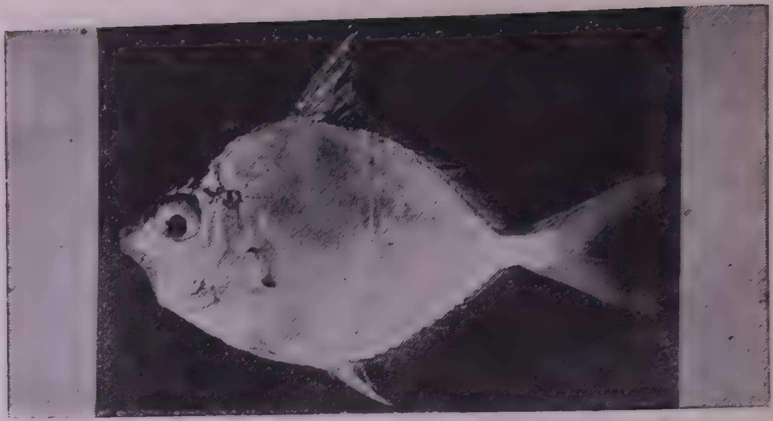

Fig. 46. *Leiognathus equulus.*

Scientific Name : *Leiognathus equulus*
Vernacular Name : 'Kurchi'
Gear : Trawl net
Peak period of occurrence : Sep. and Jan.–Feb.
Depth of occurrence : 4–50 m
Length range in commercial fishery : —
Size at first maturity : —
Spawning season : —

MULLIDAE

Popular English Name : Goat fishes
Vernacular Name (Kannada) : 'Purli'
Annual average catch : 23.7 t
Gear wise annual average catch : Trawl net : 23.72 t
Fishing methods and their contribution in total catch : Trawl net : 0.3%

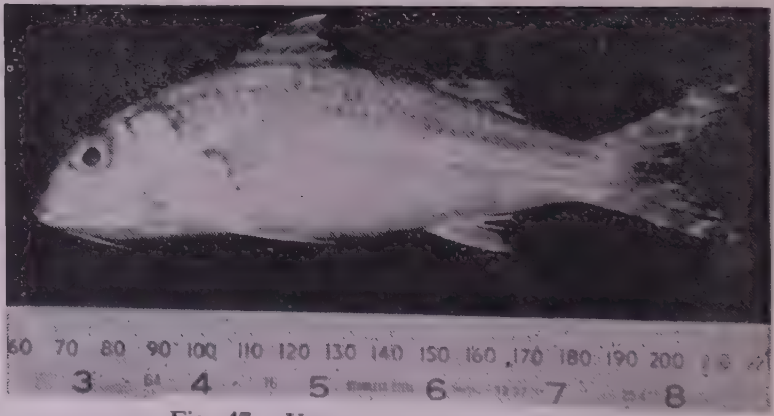

Fig. 47. *Upeneus taeniopterus.*

Scientific Name : *Upeneus taeniopterus*
Vernacular Name : 'Purli'
Gear : Trawl net
Peak period of occurrence : February–March
Depth of occurrence : 4–50 m
Length range in commercial fishery : —

Size at first maturity : —
Spawning season : —

NEMIPTERIDAE

Popular English Name : Threadfin breams
Vernacular Name (Kannada) : 'Madumagalu meenu'
Annual average catch : 999.1 t
Gear wise annual average catch : Trawl net : 999.1 t
Fishing methods and their contribution in total catch : Trawl net : 10.7%

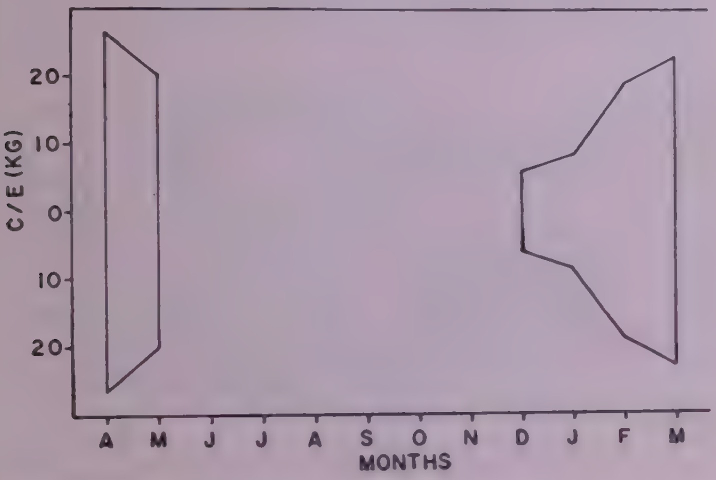

Fig. 48. Seasonal abundance of threadfin breams in the trawling grounds off Mangalore.

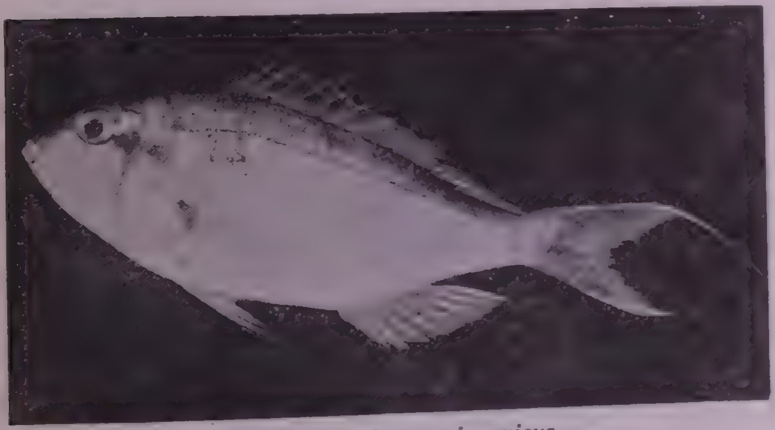

Fig. 49. *Nemipterus japonicus.*

Scientific Name : *Nemipterus japonicus*
Vernacular Name : 'Madumagalu meenu'
Gear : Trawl net
Peak period of occurrence : January–May
Depth of occurrence : 4–50 m
Length range in commercial fishery : —
Size at first maturity : —
Spawning season : —

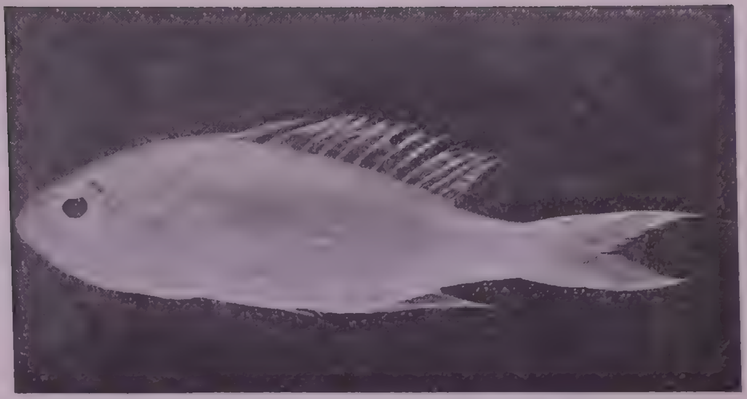

Fig. 50. *Nemipterus mesoprion.*

Scientific Name : *Nemipterus mesoprion*
Vernacular Name : 'Madumagalu meenu'
Gear : Trawl net
Peak period of occurrence : January–May
Depth of occurrence : 4–50 m
Length range in commercial fishery : —
Size at first maturity : 100 mm
Spawning season : December–April

NOMEIDAE

Popular English Name : Drift fishes
Vernacular Name (Kannada) : 'Pupper mangi'
Annual average catch : 40.3 t
Gear wise annual average catch : Trawl net : 40.31 t
Fishing methods and their contribution in total catch : Trawl net : 0.4%

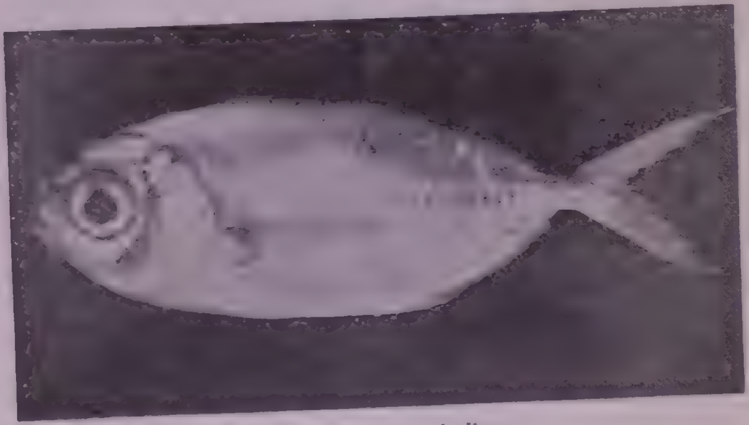

Fig. 51. *Psenes indicus.*

Scientific Name : *Psenes indicus*
Vernacular Name : 'Pupper mangi'
Gear : Trawl net
Peak period of occurrence : January–March
Depth of occurrence : 4–50 m
Length range in commercial fishery : —

Size at first maturity : 135 mm
Spawning season : —

PLATYCEPHALIDAE

Popular English Name : Spiny flat heads
Vernacular Name (Kannada) : 'Balchett'
Annual average catch : 181.9 t
Gear wise annual average catch : Trawl net : 181.86 t
Fishing methods and their contribution in total catch : Trawl net : 2.0%

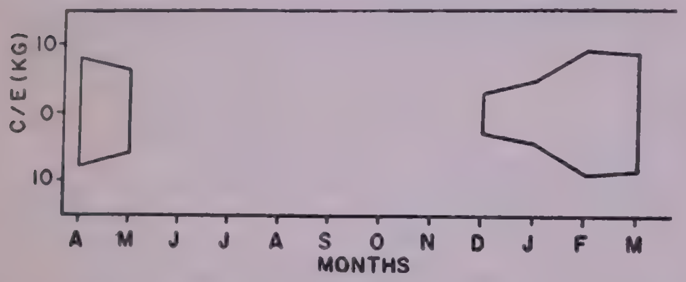

Fig. 52. Seasonal abundance of spiny flatheads in the trawling grounds off Mangalore.

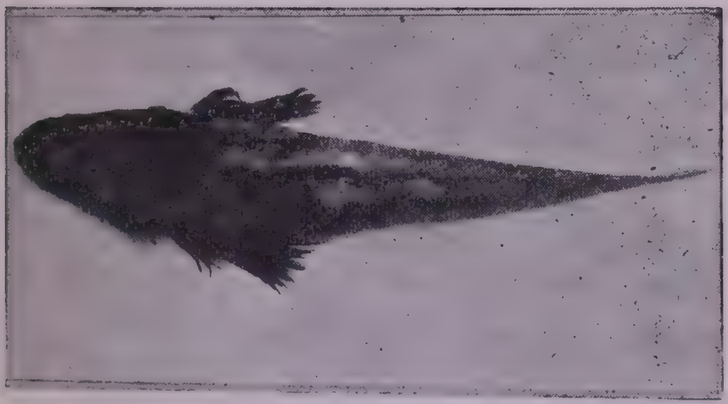

Fig. 53. *Platycephalus scaber.*

Scientific Name : *Platycephalus scaber*
Vernacular Name : 'Balchett'
Gear : Trawl net
Peak period of occurrence : January–March
Depth of occurrence : 4–50 m
Length range in commercial fishery : —
Size at first maturity : —
Spawning season : —

PRIACANTHIDAE

Popular English Name : Big eye/Bulls eye
Vernacular Name (Kannada) : 'Disco meenu'
Annual average catch : 93.3 t
Gear wise annual average catch : Trawl net : 93.23
Drift gill net : 0.03t
Fishing methods and their contribution in total catch : Trawl net : 1.0%
Drift gill net : 0.1%

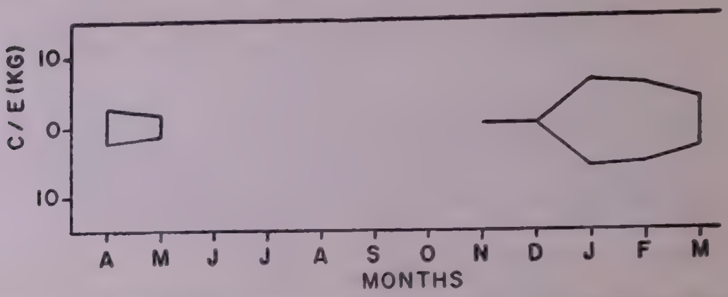

Fig. 54. Seasonal abundance of big eye in the trawling grounds off Mangalore.

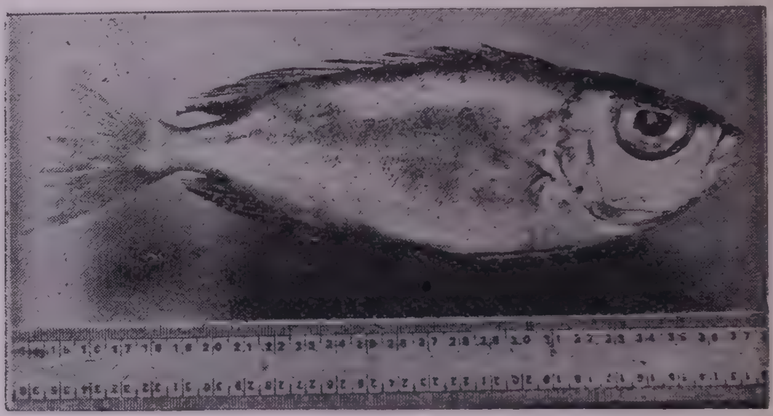

Fig. 55. *Priacanthus hamrur.*

Scientific Name : *Priacanthus hamrur*
Vernacular Name : 'Disco meenu'
Gear : Trawl net/Drift gill net
Peak period of occurrence : Jan.–Apr. and Nov.
Depth of occurrence : 4–50 m
Length range in commercial fishery : —
Size at first maturity : —
Spawning season : —

SCIAENIDAE

Popular English Name : Croackers
Vernacular Name (Kannada) : 'Kalluru'/'Koran'
Annual average catch : 399.8 t
Gear wise annual average catch : Trawl net : 341.16 t
Purse seine : 58.02 t
Drift gill net : 0.67 t
Fishing methods and their contribution in total catch : Trawl net : 3.7%
Purse seine : 0.2%
Drift gill net : 0.2%

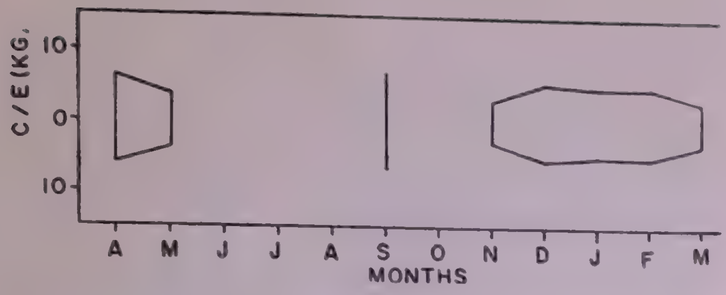

Fig. 56. Seasonal abundance of sciaenids (croackers) in the trawling grounds off Mangalore.

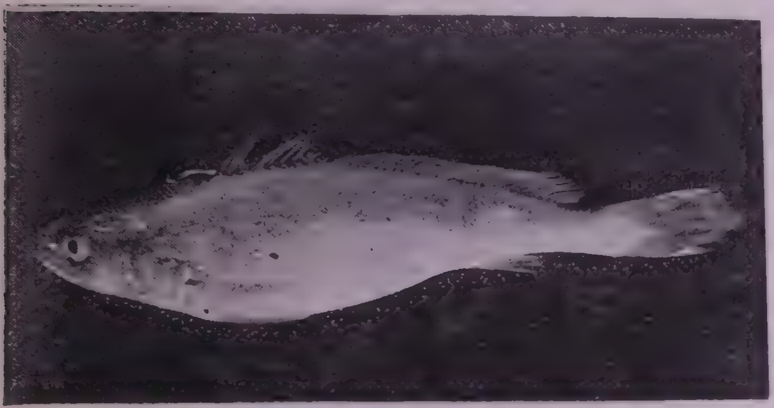

Fig. 57. *Johnieops osseus.*

Scientific Name : *Johnieops osseus*
Vernacular Name : 'Kalluru'
Gear : Trawl net/Purse seine
Peak period of occurrence : Oct. and Dec.–Apr.
Depth of occurrence : 4–50 m
Length range in commercial fishery : 130–150 mm
Size at first maturity : 120 mm
Spawning season : Throughout the year

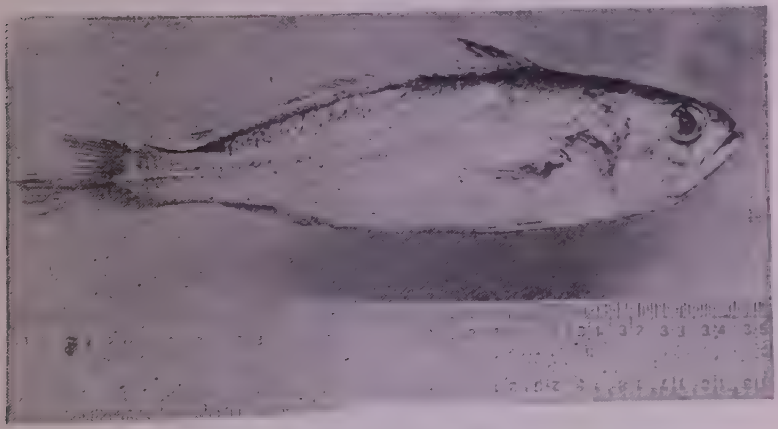

Fig. 58. *Otolithes ruber.*

Scientific Name : *Otolithes ruber*
Vernacular Name : 'Kalluru'
Gear : Trawl net
Peak period of occurrence : December–April
Depth of occurrence : 4–50 m
Length range in commercial fishery : 110–200 mm
Size at first maturity : 140 mm
Spawning season : October–January

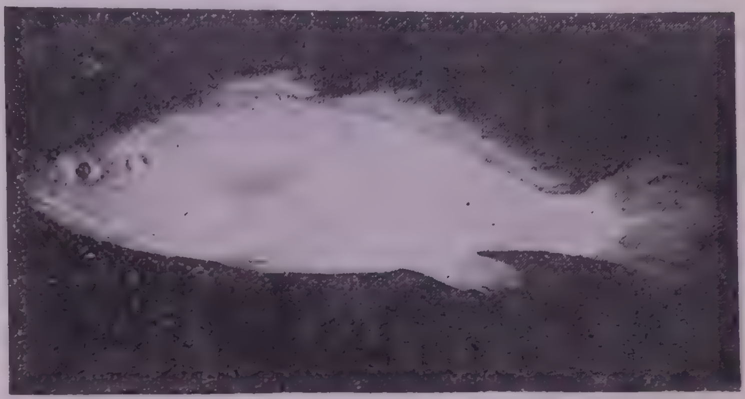

Fig. 59. *Otolithes cuvieri.*

Scientific Name : *Otolithes cuvieri*
Vernacular Name : 'Kalluru'
Gear : Trawl net
Peak period of occurrence : December–April
Depth of occurrence : 4–50 m
Length range in commercial fishery : 150–250 mm
Size at first maturity : —
Spawning season : —

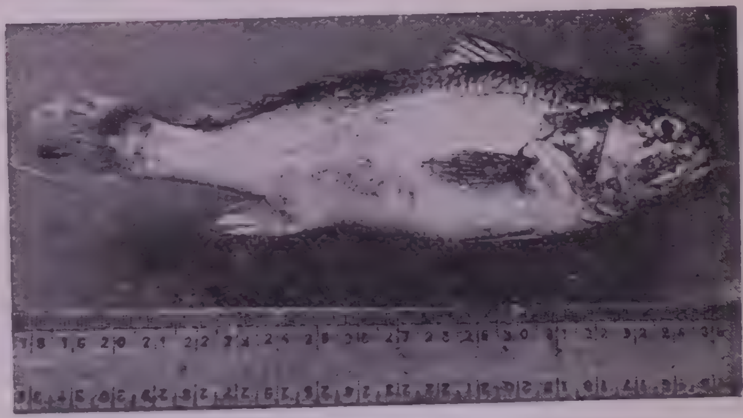

Fig. 60. *Johnieops dussumieri.*

Scientific Name : *Johnieops dussumieri*
Vernacular Name : 'Kalluru'
Gear : Trawl net
Peak period of occurrence : December–April
Depth of occurrence : 4–50 m
Length range in commercial fishery : 130–150 mm
Size at first maturity : —
Spawning season : —

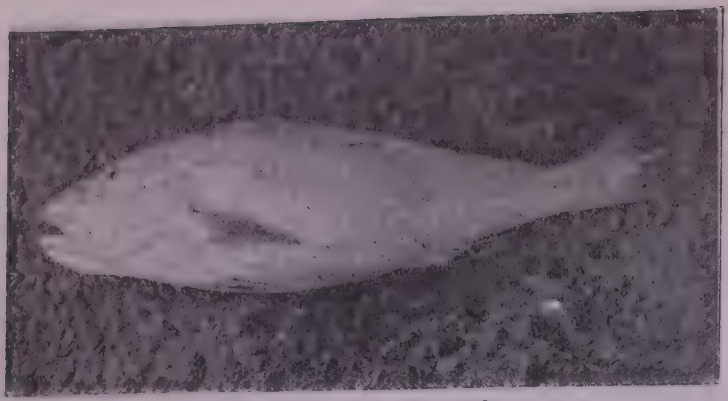

Fig. 61. *Protonibea diacanthus.*

Scientific Name : *Protonibea diacanthus*
Vernacular Name : 'Koran'
Gear : Drift gill net
Peak period of occurrence : February
Depth of occurrence : 18–45 m
Length range in commercial fishery : —
Size at first maturity : —
Spawning season : —

SCOMBRIDAE

Popular English Name : Mackerel/Tunas/Seer fishes
Vernacular Name (Kannada) : 'Banguda'/'Kedar'/'Anjal'
Annual average catch : 5,773.3 t
Gear wise annual average catch : Purse seine : 5,532.64 t
Drift gill net : 240.97 t
Trawl net : 3.70 t
Fishing methods and their contribution in total catch : Drift gill net : 59.1%
Purse seine : 16.3%
Trawl net : 0.1%

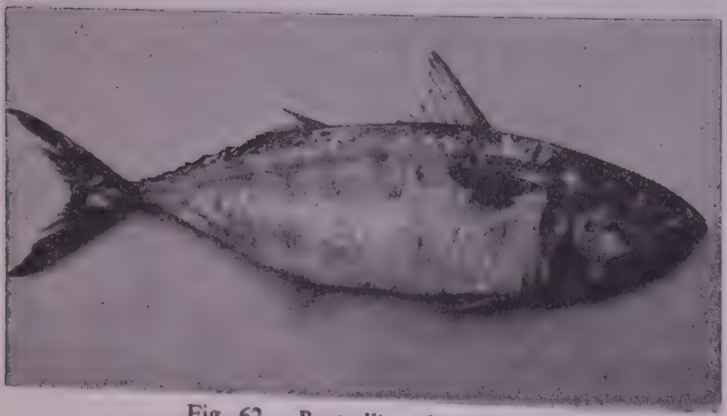

Fig. 62. *Rastrelliger kanagurta.*

Scientific Name : *Rastrelliger kanagurta*
Vernacular Name : 'Banguda'
Gear : Purse seine/Drift gill net/Trawl net
Peak period of occurrence : Sep.–Nov. and Mar.
Depth of occurrence : 4–50 m
Length range in commercial fishery : 165–439 mm
Size at first maturity : 217 mm
Spawning season : June–August

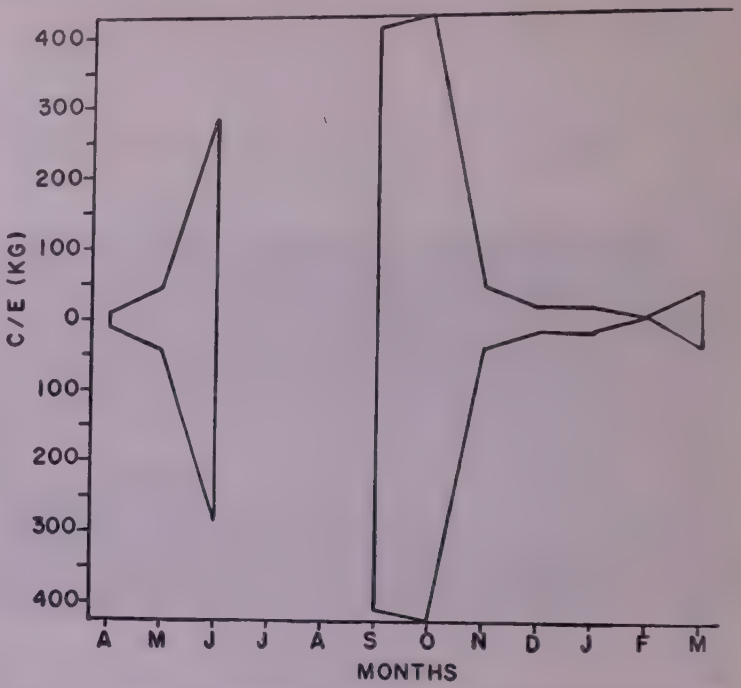

Fig. 63. Seasonal abundance of mackerel in the purse seining grounds off Mangalore.

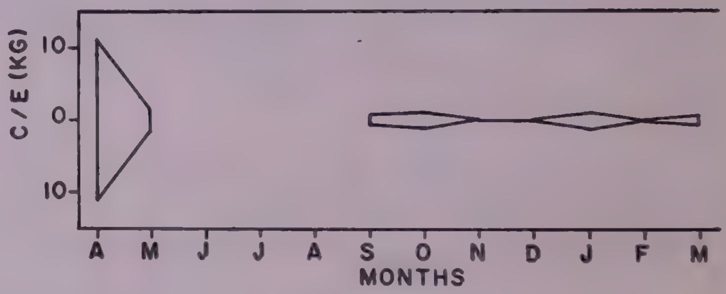

Fig. 64. Seasonal abundance of mackerel in the drift gill netting grounds off Mangalore.

TUNAS

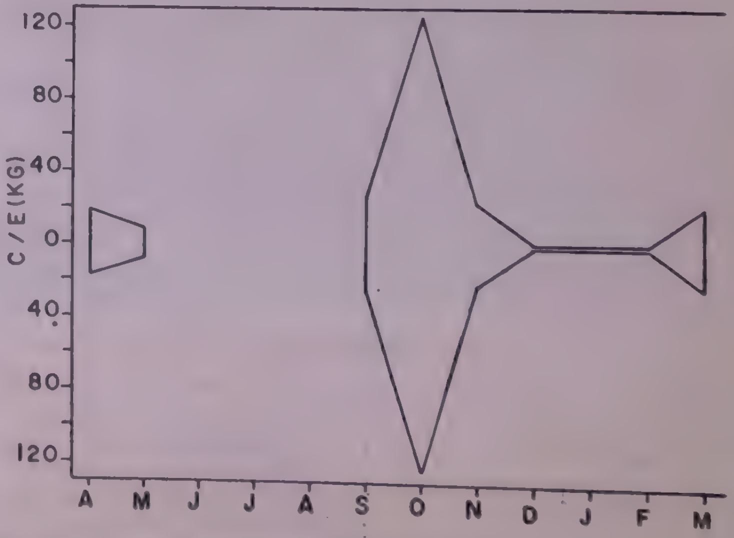

Fig. 65. Seasonal abundance of tunas in the purse seining grounds off Mangalore.

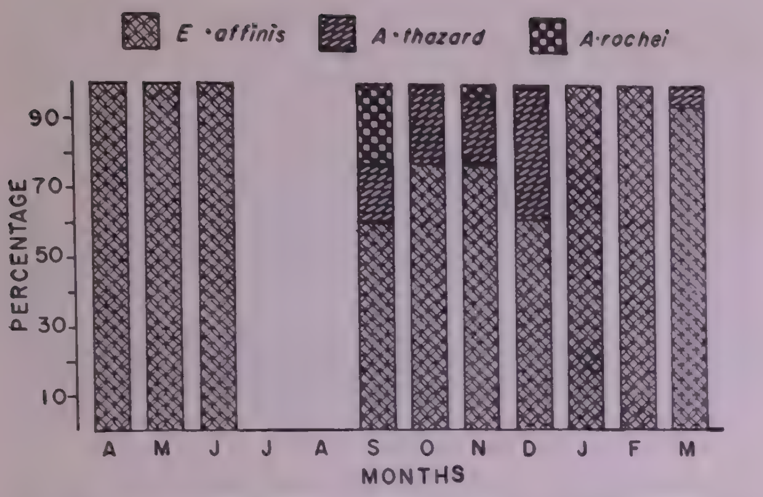

Fig. 66. Month-wise species composition of tunas landed by purse seiners.

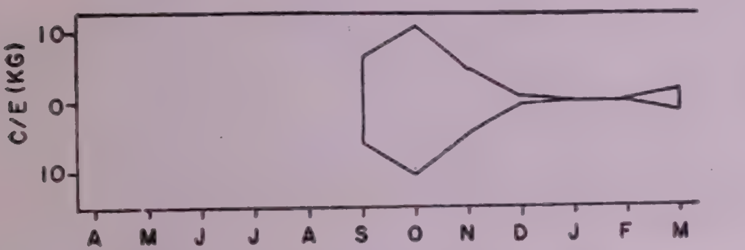

Fig. 67. Seasonal abundance of tunas and bill fishes in the drift gill netting grounds off Mangalore.

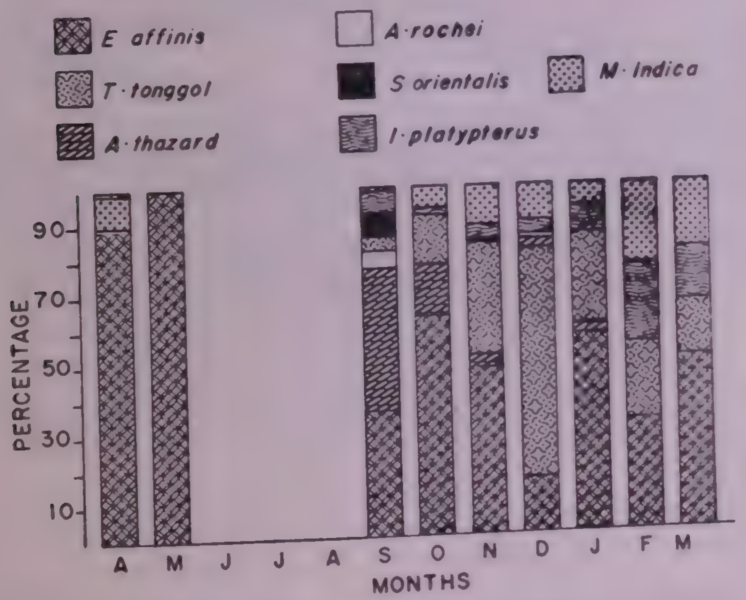

Fig. 68. Month-wise species composition of tunas and bill fishes landed by drift gill netters.

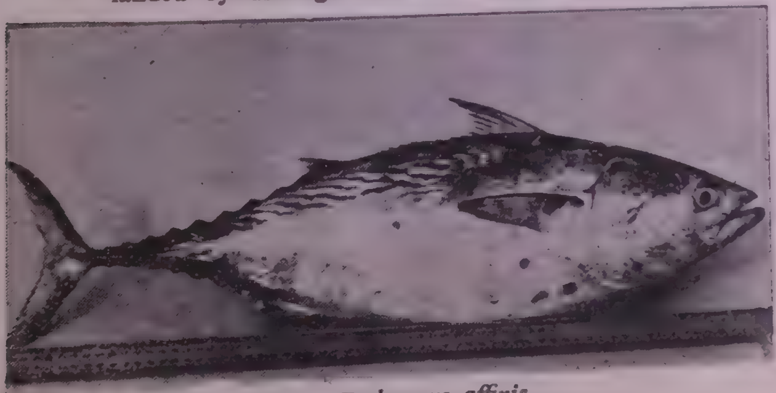

Fig. 69. *Euthynnus affinis.*

Scientific Name	:	*Euthynnus affinis*
Vernacular Name	:	'Peepa kedar'
Gear	:	Purse seine/Drift gill net
Peak period of occurrence	:	September–November
Depth of occurrence	:	15–45 m
Length range in commercial fishery	:	340–499 mm
Size at first maturity	:	430 mm
Spawning season	:	September–October

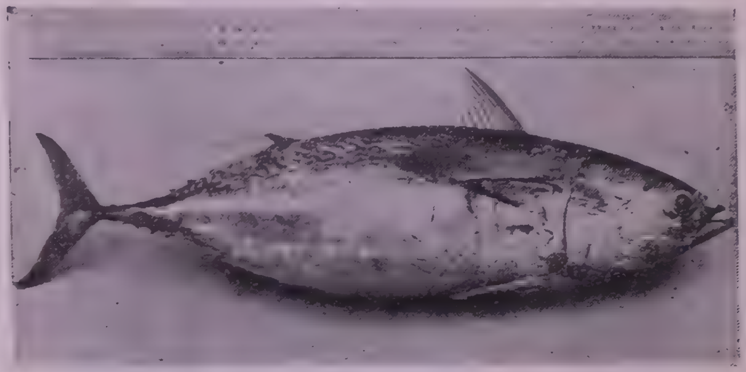

Fig. 70. *Auxis thazard.*

Scientific Name	:	*Auxis thazard*
Vernacular Name	:	'Baremeenu'/'Kedar'
Gear	:	Purse seine/Drift gill net
Peak period of occurrence	:	September–December
Depth of occurrence	:	15–45 m
Length range in commercial fishery	:	260–439 mm
Size at first maturity	:	305 mm
Spawning season	:	October–November

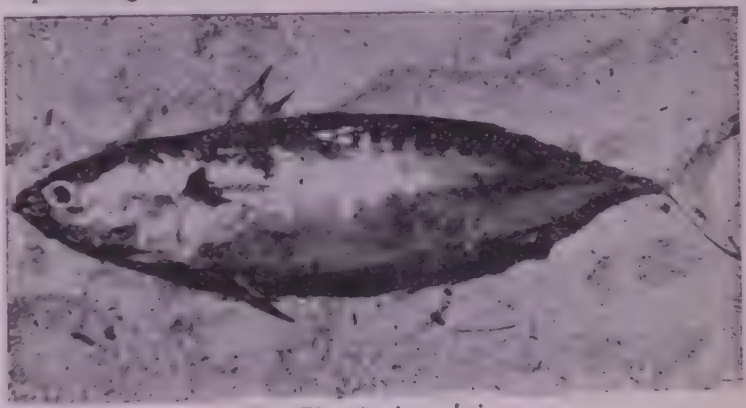

Fig. 71. *Auxis rochei.*

Scientific Name	:	*Auxis rochei*
Vernacular Name	:	'Sheerad kedar'
Gear	:	Drift gill net
Peak period of occurrence	:	September–December
Depth of occurrence	:	15–35 m
Length range in commercial fishery	:	200–300 mm
Size at first maturity	:	238 mm
Spawning season	:	September

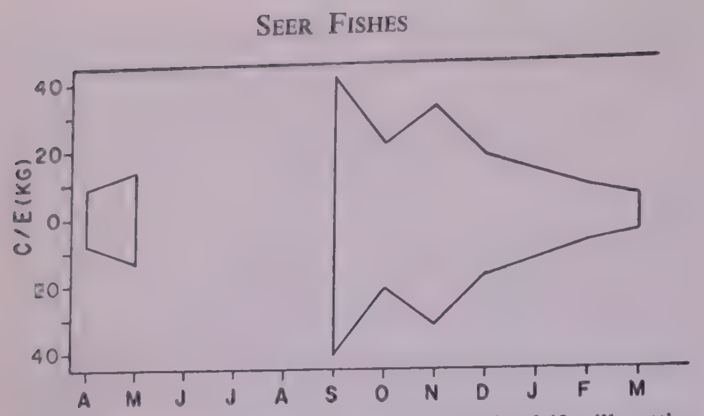

Fig. 72. Seasonal abundance of seer fishes in the drift gill netting grounds off Mangalore.

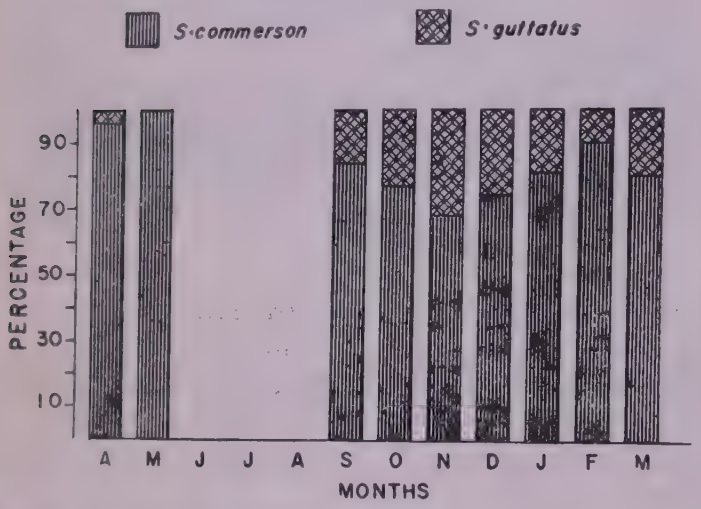

Fig. 73. Month-wise species composition of seer fishes landed by drift gill netters.

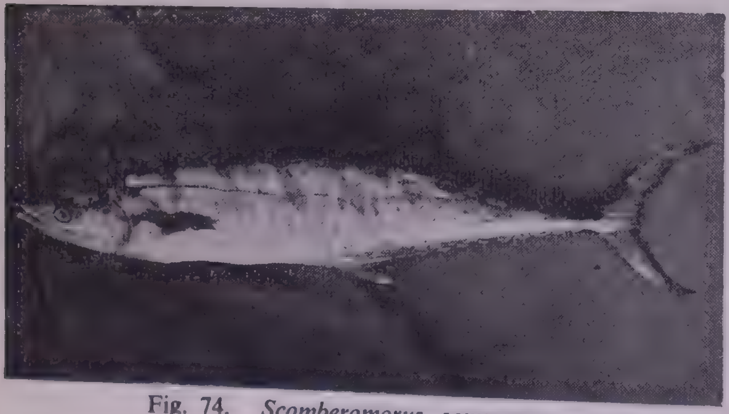

Fig. 74. *Scomberomorus commerson.*

Scientific Name	:	*Scomberomorus commerson*
Vernacular Name	:	'Anjal'
Gear	:	Drift gill net/Trawl net
Peak period of occurrence	:	Sep.–Dec. and Mar.
Depth of occurrence	:	4–50 m
Length range in commercial fishery	:	460–900 mm
Size at first maturity	:	740 mm
Spawning season	:	January–September

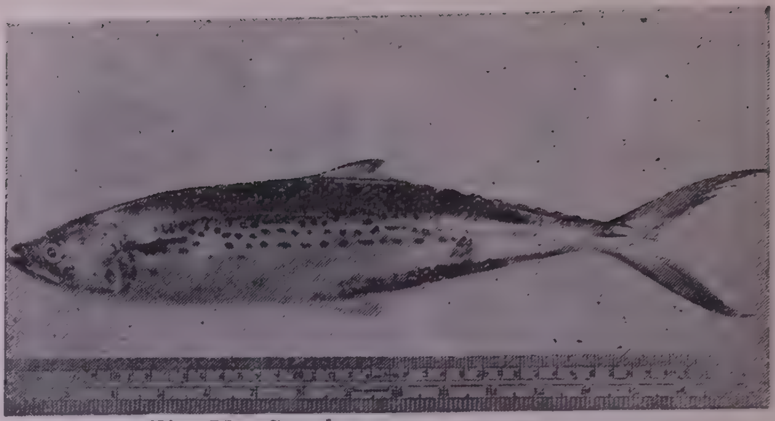

Fig. 75. *Scomberomorus guttatus.*

Scientific Name	:	*Scomberomorus guttatus*
Vernacular Name	:	'Anjal'
Gear	:	Drift gill net
Peak period of occurrence	:	October–December
Depth of occurrence	:	18–45 m
Length range in commercial fishery	:	360–460 mm
Size at first maturity	:	365 mm
Spawning season	:	April--July

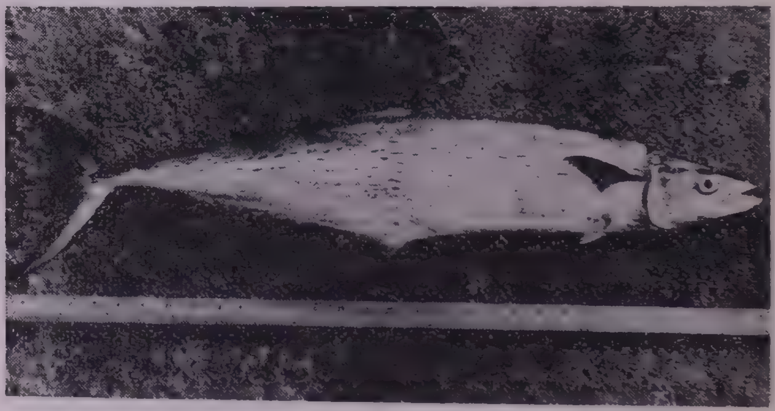

Fig. 76. *Scomberomorus lineolatus.*

Scientific Name	:	*Scomberomorus lineolatus*
Vernacular Name	:	'Anjal'
Gear	:	Drift gill net
Peak period of occurrence	:	November–January
Depth of occurrence	:	18–45 m
Length range in commercial fishery	:	—
Size at first maturity	:	—
Spawning season	:	—

SPHYRAENIDAE

Popular English Name	:	Barracudas		
Vernacular Name (Kannada)	:	'Surula kandai'		
Annual average catch	:	17.2 t		
Gear wise annual average catch	:	Trawl net	:	15.97 t
		Drift gill net	:	1.25 t

Fishing methods and their
contribution in total catch : Drift gill net : 0.3%
Trawl net : 0.2%

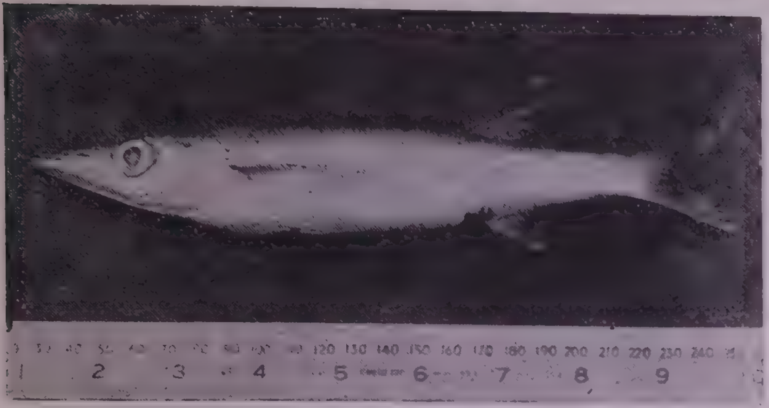

Fig. 77. *Sphyraena obtusata.*

Scientific Name : *Sphyraena obtusata*
Vernacular Name : 'Surula kandai'
Gear : Trawl net
Peak period of occurrence : March
Depth of occurrence : 4–50 m
Length range in commercial fishery : —
Size at first maturity : —
Spawning season : —

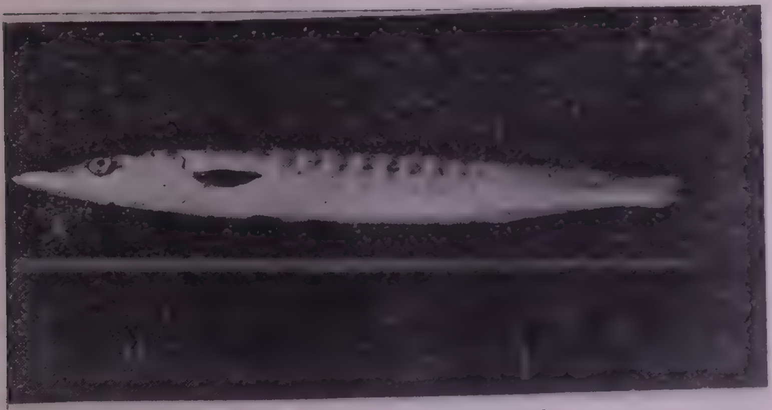

Fig. 78. *Sphyraena barracuda.*

Scientific Name : *Sphyraena barracuda*
Vernacular Name : 'Surula kandai'
Gear : Drift gill net
Peak period of occurrence : November
Depth of occurrence : 18–45 m
Length range in commercial fishery : —
Size at first maturity : —
Spawning season : —

STROMATEIDAE

Popular English Name : Pomfrets
Vernacular Name (Kannada) : 'Manji'
Annual average catch : 113.7 t
Gear wise annual average catch : Trawl net : 43.93 t
Purse seine : 38.28 t
Drift gill net : 31.51 t
Fishing methods and their contribution in total catch : Drift gill net : 7.7%
Trawl net : 0.5%
Purse seine : 0.1%

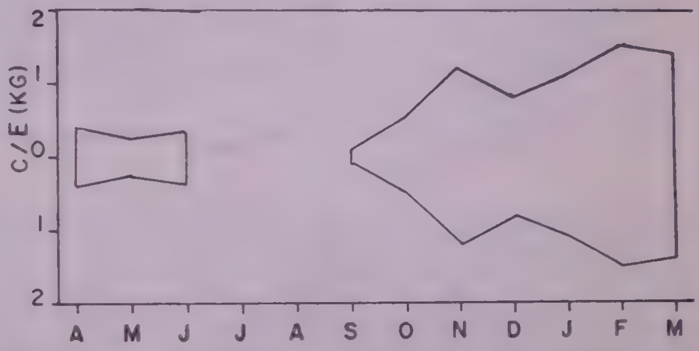

Fig. 79. Seasonal abundance of pomfrets in the trawling grounds off Mangalore.

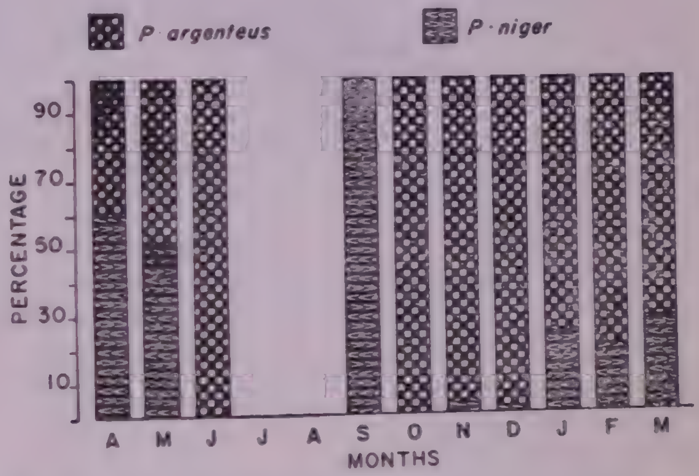

Fig. 80. Month-wise species composition of pomfrets landed by shrimp trawlers.

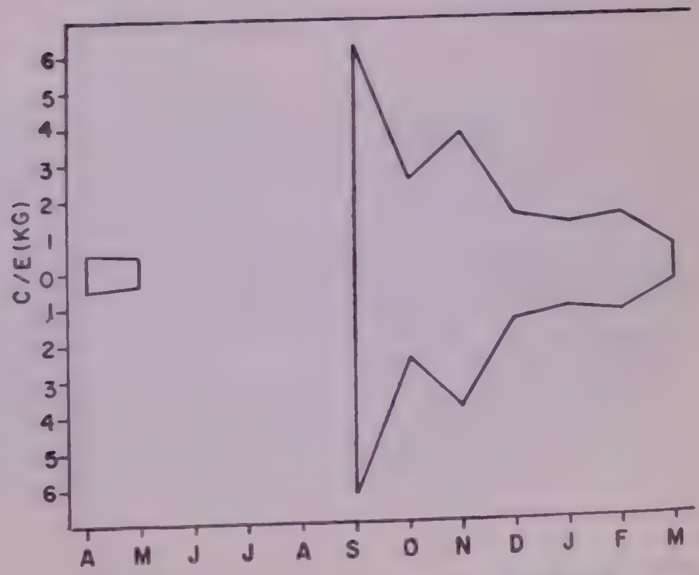

Fig. 81. Seasonal abundance of pomfrets in the drift gill netting grounds off Mangalore.

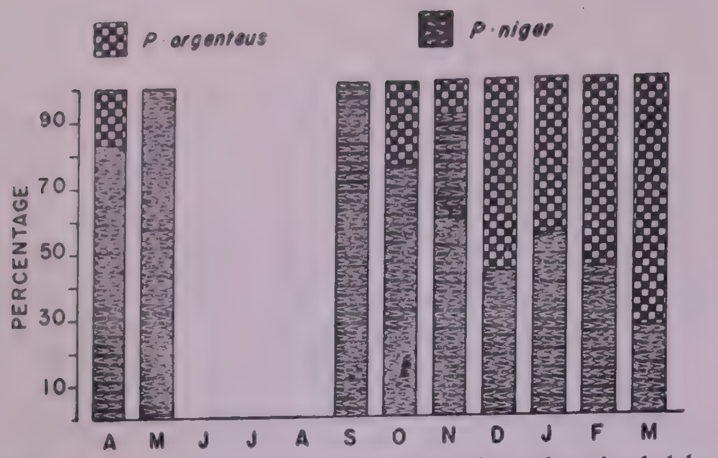

Fig. 82. Month-wise species composition of pomfrets landed by drift gill netters.

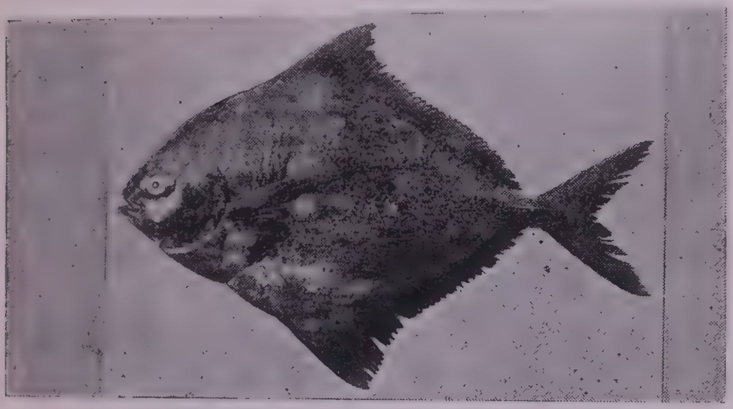

Fig. 83. *Parastromateus niger*.

Scientific Name : *Parastromateus niger*
Vernacular Name : 'Kappu manji'
Gear : Drift gill net/Trawl net/ Purse seine
Peak period of occurrence : September–April
Depth of occurrence : 4–50 m
Length range in commercial fishery : 140–320 mm
Size at first maturity : 290 mm
Spawning season : October–December

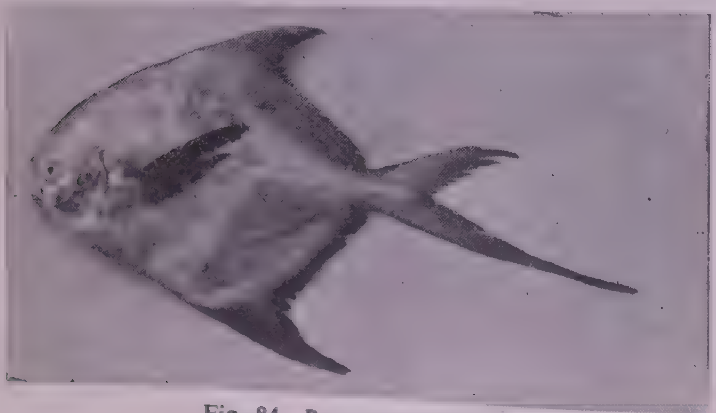

Fig. 84. *Pampus argenteus*.

Scientific Name : *Pampus argenteus*
Vernacular Name : 'Boldhu manji'
Gear : Drift gill net/Trawl net
Peak period of occurrence : October–April
Depth of occurrence : 4–50 m
Length range in commercial fishery : 50–240 mm
Size at first maturity : 180 mm
Spawning season : April–June

SYNODONTIDAE

Popular English Name : Lizard fishes
Vernacular Name (Kannada) : 'Arane meenu'
Annual average catch : 443.5 t
Gear wise annual average catch : Trawl net : 443.48 t
Fishing methods and their contribution in total catch : Trawl net : 4.8%

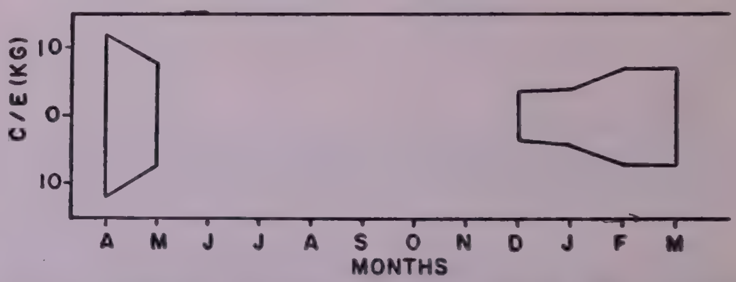

Fig. 85. Seasonal abundance of lizard fishes in the trawling grounds off Mangalore.

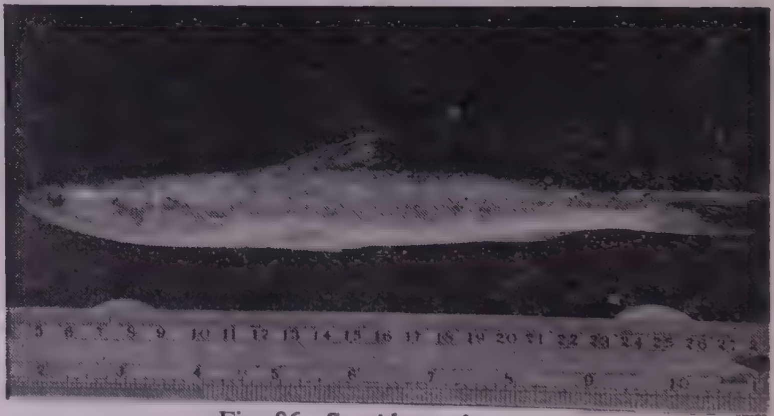

Fig. 86. *Saurida undosquamis*.

Scientific Name : *Saurida undosquamis*
Vernacular Name : 'Arane meenu'
Gear : Trawl net
Peak period of occurrence : January–May
Depth of occurrence : 4–50 m
Length range in commercial fishery : —
Size at first maturity : 240 mm
Spawning season : October–March

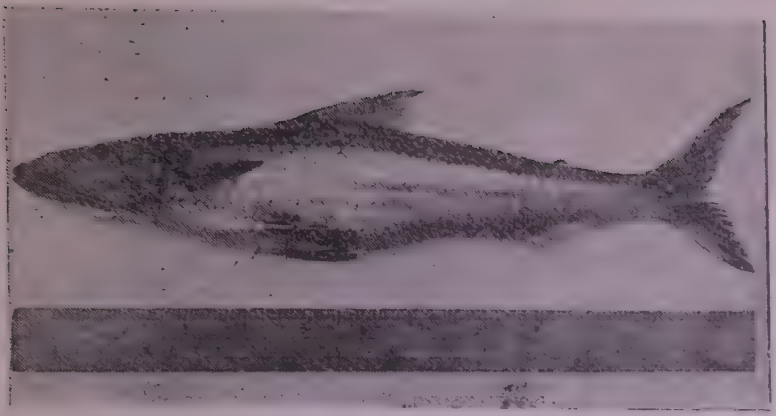

Fig. 87. *Saurida tumbil.*

Scientific Name : *Saurida tumbil*
Vernacular Name : 'Arane meenu'
Gear : Trawl net
Peak period of occurrence : January–May
Depth of occurrence : 4–50 m
Length range in commercial fishery : 113–404 mm
Size at first maturity : 260 mm
Spawning season : October–January

TACHYSURIDAE

Popular English Name : Cat fishes
Vernacular Name (Kannada) : 'Thede'/'Shede'
Annual average catch : 2,325.3 t
Gear wise annual average catch : Purse seine : 2,072.08 t
Trawl net : 209.80 t
Drift gill net : 43.40 t

Fishing methods and their contribution in total catch: Drift gill net : 10.7%
Purse seine : 6.1%
Trawl net : 2.3%

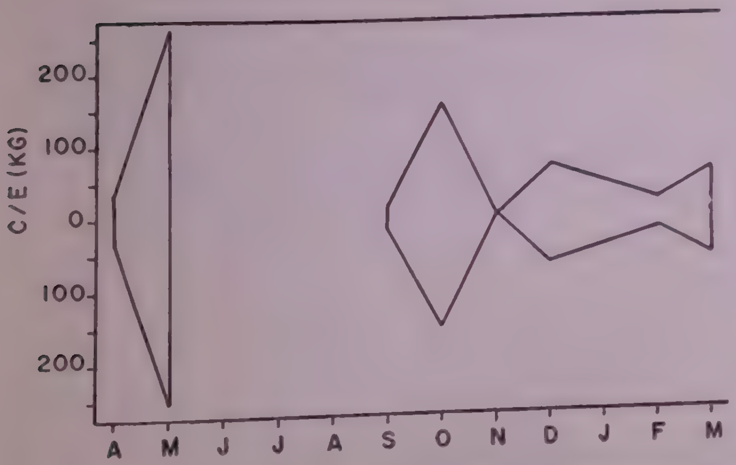

Fig. 88. Seasonal abundance of cat fishes in the purse seining grounds off Mangalore.

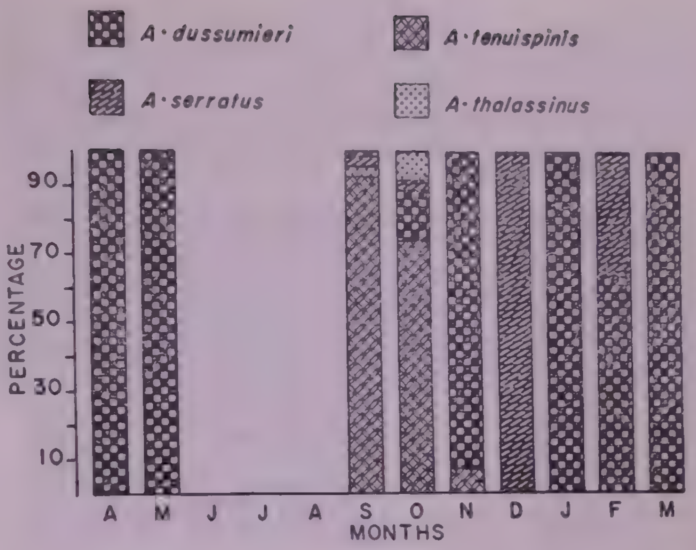

Fig. 89. Month-wise species composition of cat fishes landed by purse seiners.

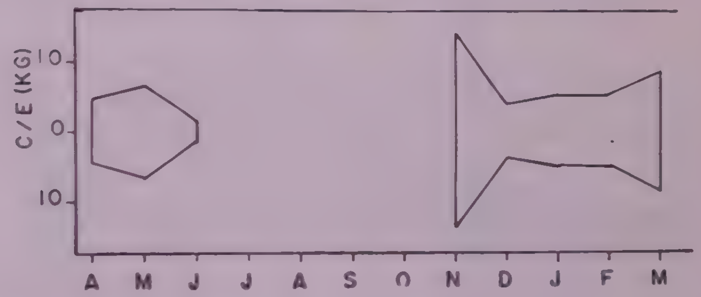

Fig. 90. Seasonal abundance of cat fishes in the trawling grounds off Mangalore.

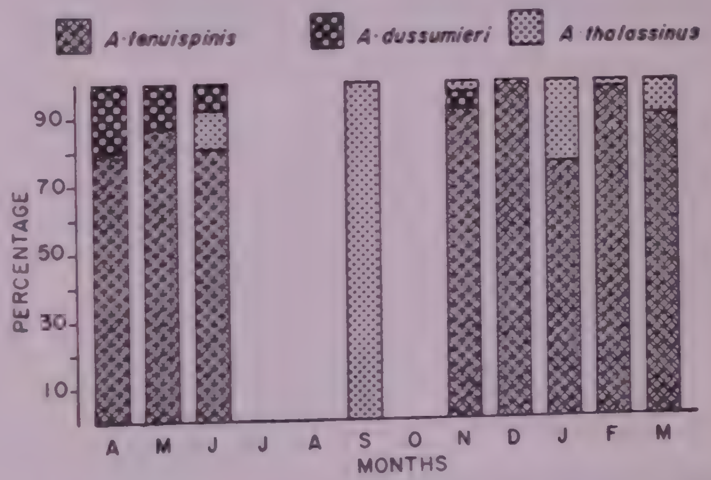

Fig. 91. Month-wise species composition of cat fishes landed by shrimp trawlers.

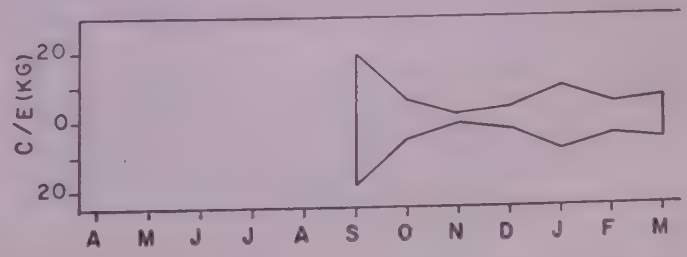

Fig. 92. Seasonal abundance of cat fishes in the drift gill netting grounds off Mangalore.

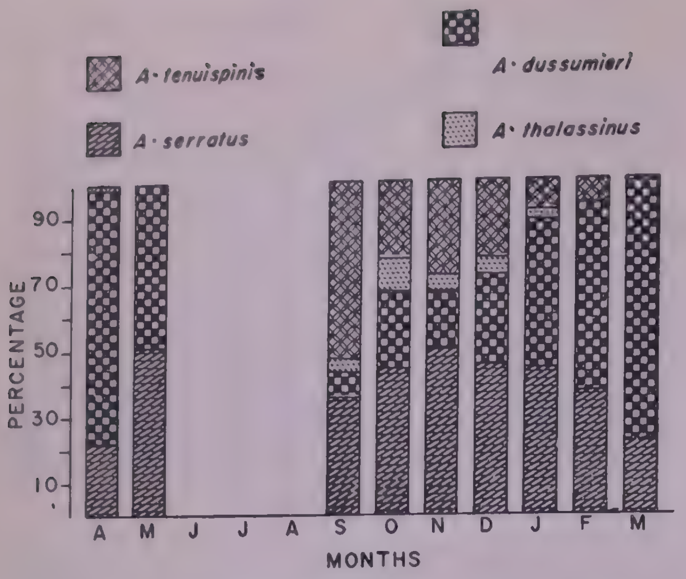

Fig. 93. Month-wise species composition of cat fishes landed by drift gill netters.

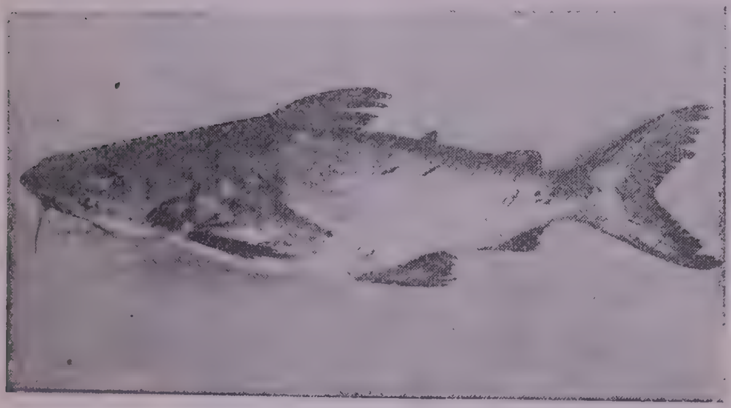

Fig. 94. *Tachysurus dussumieri.*

Scientific Name	:	*Tachysurus dussumieri*
Vernacular Name	:	'Thede' / 'Shede'
Gear	:	Purse seine/Drift gill net
Peak period of occurrence	:	October–May
Depth of occurrence	:	15–45 m
Length range in commercial fishery	:	580–779 mm
Size at first maturity	:	545 mm
Spawning season	:	February–March

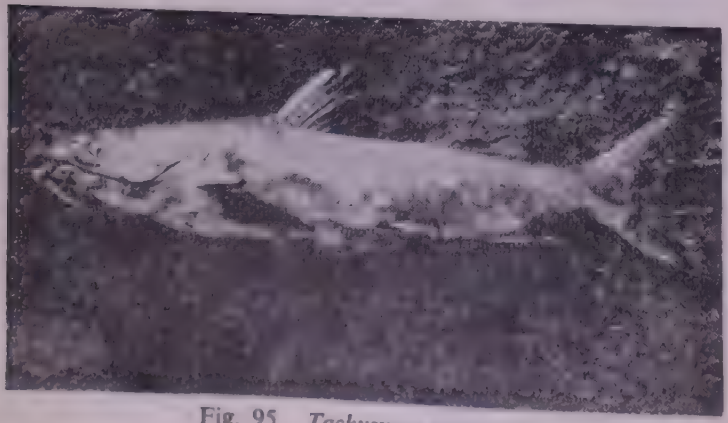

Fig. 95. *Tachysurus tenuispinis.*

Scientific Name	:	*Tachysurus tenuispinis*
Vernacular Name	:	'Thede'/'Shede'
Gear	:	Purse seine/Trawl net/ Drift gill net
Peak period of occurrence	:	September–May
Depth of occurrence	:	10–45 m
Length range in commercial fishery	:	160–459 mm
Size at first maturity	:	275 mm
Spawning season	:	Sept.–Oct. and Dec.

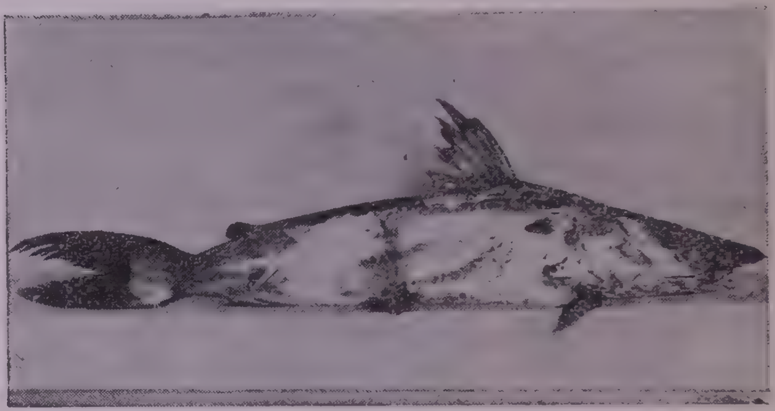

Fig. 96. *Tachysurus serratus.*

Scientific Name	:	*Tachysurus serratus*
Vernacular Name	:	'Thede'/'Shede'
Gear	:	Drift gill net
Peak period of occurrence	:	September–January
Depth of occurrence	:	18–45 m
Length range in commercial fishery	:	800–1,050 mm
Size at first maturity	:	—
Spawning season	:	—

TRICHIURIDAE

Popular English Name	:	Ribbon fishes
Vernacular Name (Kannada)	:	'Pambol'
Annual average catch	:	444.8 t
Gear wise annual average catch	:	Trawl net : 444.22 t Drift gill net : 0.54 t
Fishing method and their contribution in total catch	:	Trawl net : 4.8 % Drift gill net : 0.1 %

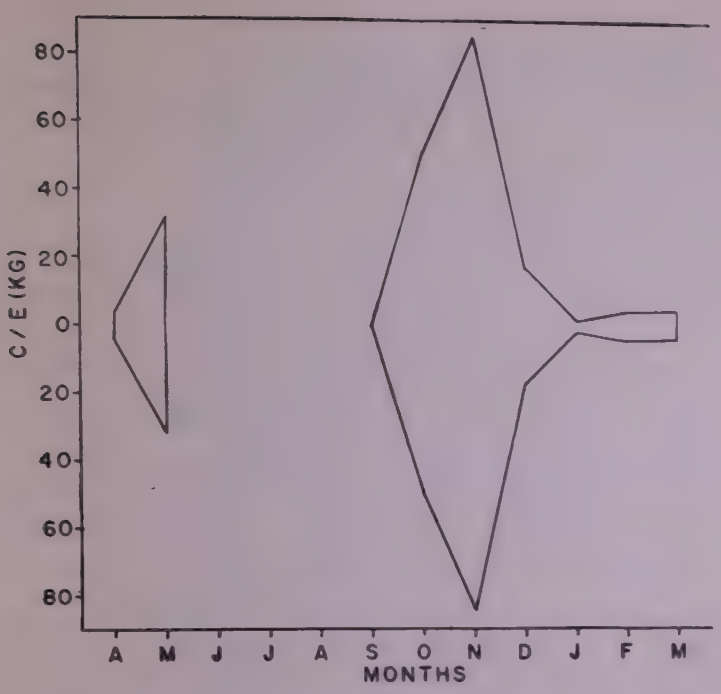

Fig. 97. Seasonal abundance of ribbon fishes in the trawling grounds off Mangalore.

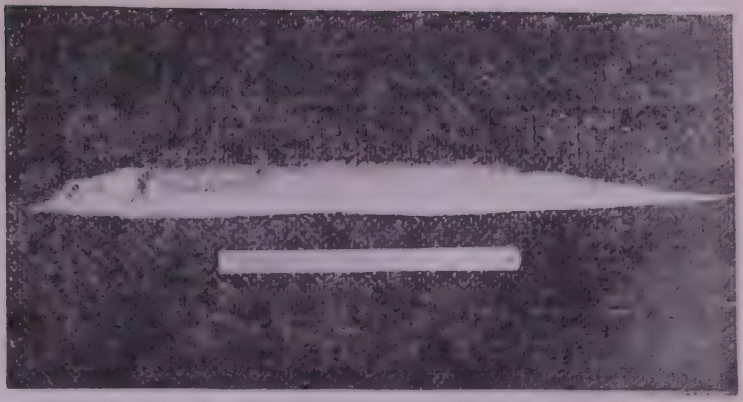

Fig. 98. *Trichiurus lepturus.*

Scientific Name	:	*Trichiurus lepturus*
Vernacular Name	:	'Pambol'
Gear	:	Trawl net/Drift gill net
Peak period of occurrence	:	Oct.–Dec. and May
Depth of occurrence	:	4–50 m
Length range in commercial fishery	:	—
Size at first maturity	:	431 mm (S.L)
Spawning season	:	Throughout the year

* * *

GROWTH OF LARVAE AND SPAT OF THE GREEN MUSSEL *PERNA VIRIDIS* (LINNAEUS) IN HATCHERY*

Fertilised eggs and larvae of the green mussel *Perna viridis* (Linnaeus) obtained from the spawning of mussels in confinement were reared in the Kovalam Field Laboratory of the Central Marine Fisheries Research Institute and over 20,000 mussel spat have been produced successfully. The mussels in maturing stage were collected on 15-5-'87, kept in 50 l fibreglass tanks and conditioned for maturation by feeding them with phytoplankters like *Chaetoceros, Skeletonema etc.* They became mature and spawned on 22-5-'87 without any inducement, except for daily change of water. The water temperature at the time of spawning was 30.1°C and salinity 38‰.

On the completion of spawning, the mussels were removed and the spawn was kept undisturbed for 1 hr. Fertilized eggs, measuring 0.040–0.064 mm, were observed to sink to the bottom at first and after gastrulation

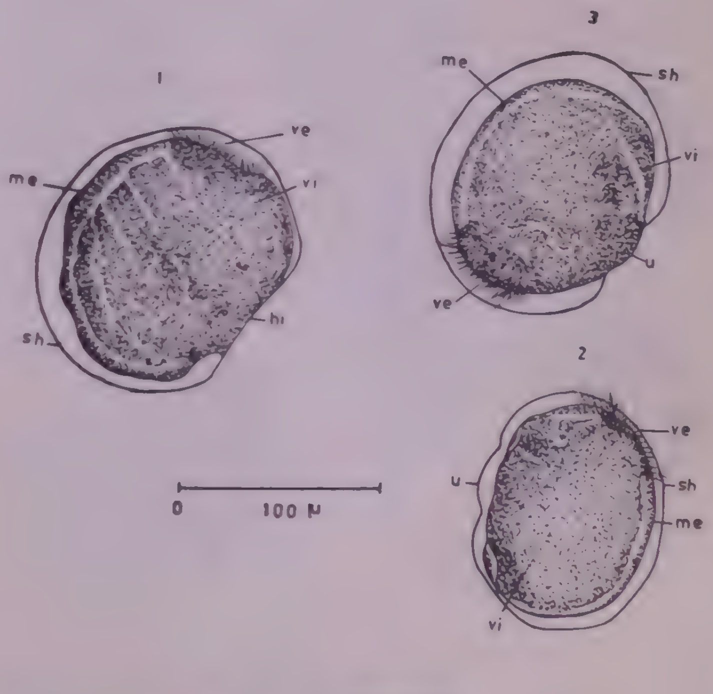

Fig. 1. 1 D-shaped veliger (4 days old)
2 Early umbo stage veliger (6 days old)
3 Umbo stage veliger (7 days old)

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*Prepared by P. V. Sreenivasan, K. Satyanarayana Rao, P. Poovannan and R. Thangavelu, Madras Research Centre of CMFRI, Madras.

Table 1. *Growth of the larvae and spat of* P. viridis *in the laboratory*

Day after fertilization	Length (mm)		Breadth (mm)		Height (mm)		Stage
	Range	Mean	Range	Mean	Range	Mean	
4th	0.048–0.096	0.065	0.048–0.112	0.096	—	—	D-shaped
7th	0.064–0.112	0.090	0.080–0.128	0.098	—	—	D-shaped & early umbo
11th	0.080–0.192	0.109	0.096–0.224	0.119	—	—	Umbo
15th	0.112–0.272	0.176	0.128–0.272	0.196	—	—	Pediveliger & eyed
19th	0.176–0.384	0.264	0.176–0.352	0.264	—	—	Plantigrade
23rd	0.224–0.498	0.298	0.224–0.432	0.306	—	—	Plantigrade
27th	0.256–0.720	0.449	0.272–0.640	0.429	—	—	Spat
31st	0.480–2.000	0.959	0.400–1.600	0.775	—	—	Spat
33rd	0.720–1.840	1.155	0.600–1.440	0.853	—	—	Spat
37th	0.880–4.000	1.753	0.600–2.440	1.195	—	—	Spat
40th	1.400–2.520	1.940	0.800–1.920	1.393	—	—	Spat
44th	1.700–5.000	3.500	0.900–2.500	1.700	0.200–1.200	0.700	Spat
48th	1.400–6.200	3.600	0.700–3.200	1.800	0.100–1.300	0.700	Spat
52nd	1.400–6.200	4.000	0.500–4.000	1.900	0.200–2.000	0.800	Spat
56th	2.500–8.300	4.500	1.400–4.700	2.800	0.800–2.900	1.600	Spat
60th	3.600–9.600	5.900	2.000–5.400	3.500	0.700–3.300	2.100	Spat

and appearance of cilia, they moved towards the surface. The water was then filtered through 40 µ filter to retain only healthy embryos. Further rearing was done in three 50 l fibreglass tanks.

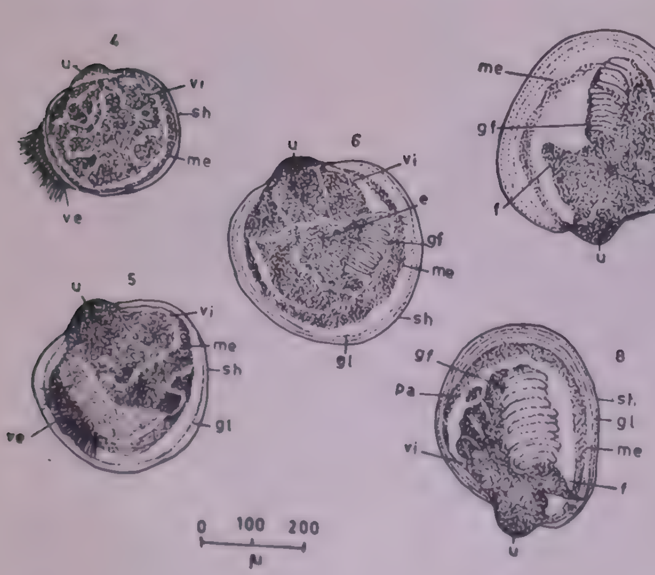


Fig. 2. 4 Umbo stage veliger (10 days old)
5 Pedi-veliger stage (12 days old)
6 Eyed-stage (15 days old)
7 Plantigrade (19 days old)
8 Spat (27 days old)

Trochophore stage was attained 6–8 hours after spawning and the D-shaped veliger by 20–24 hours. The umbo-stage was reached by 7–9 days and the foot was formed between 10 and 14 days after spawning. With the formation of foot and disappearance of ciliated velum, the larvae tended to settle and at this stage, known as plantigrade, was observed on the 19th day.

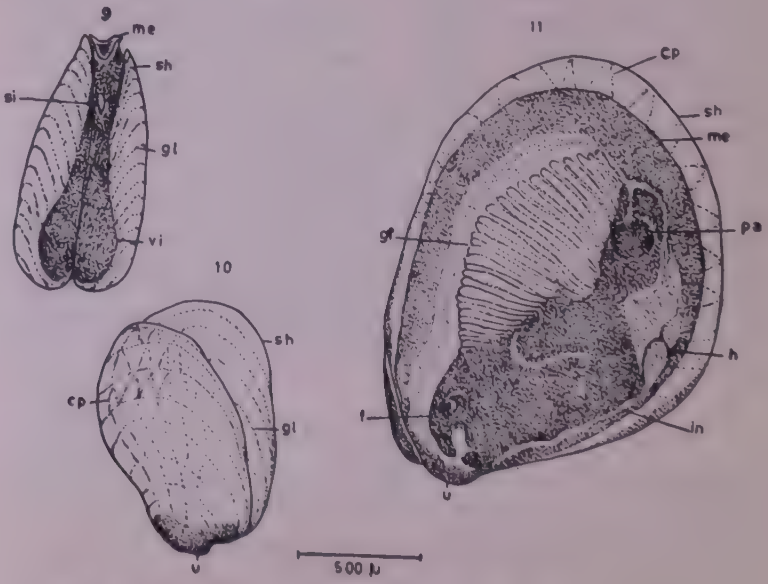
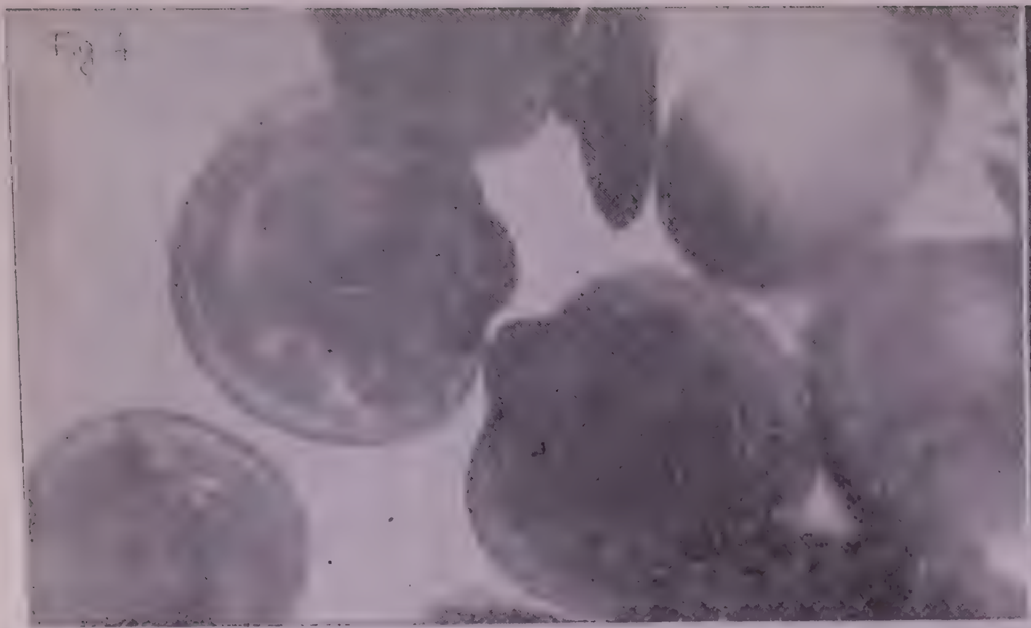
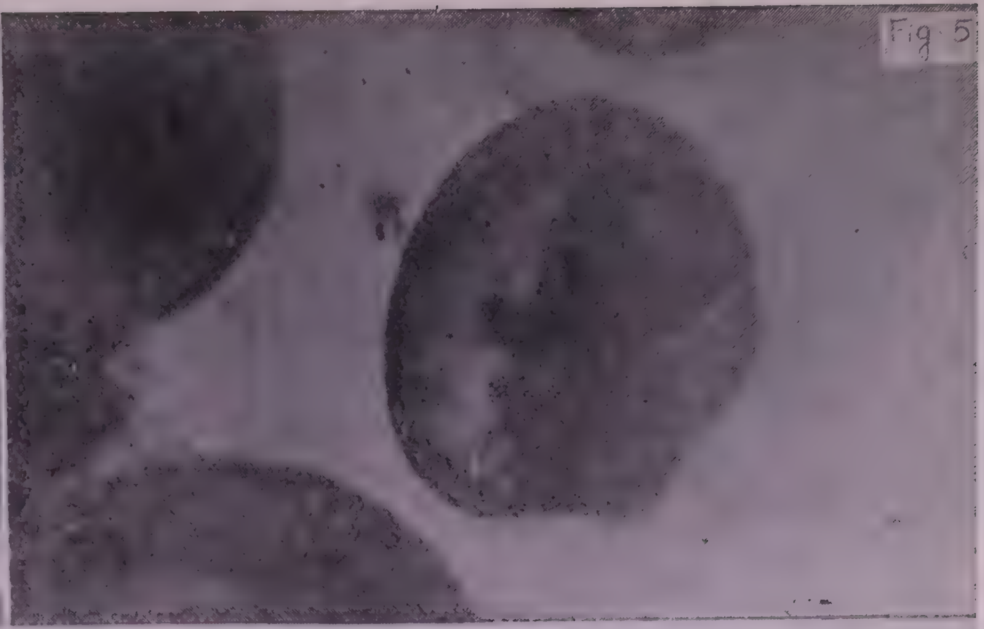
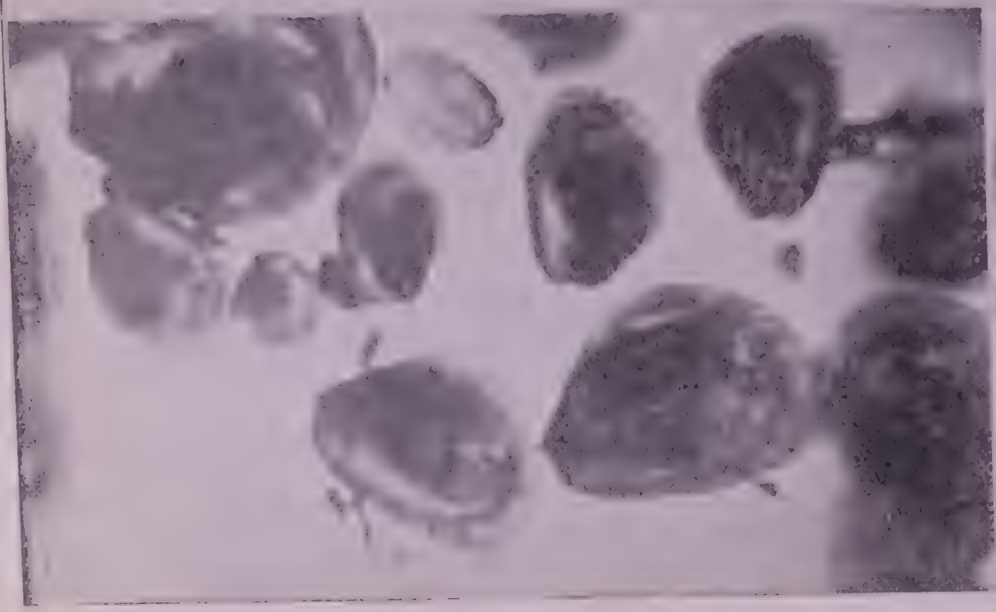


Fig. 3. 9 Anterior view of 33 days old spat
10 Empty shell of 37 days old spat
11 45 days old spat







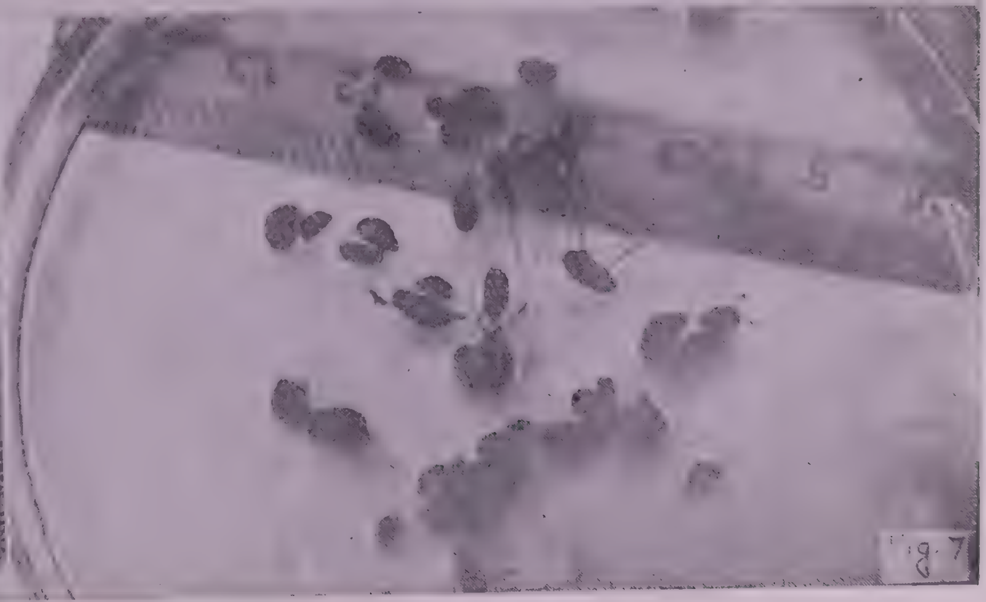


Fig. 4. Umbo stage larva.

Fig. 5. 27 days old spat.

Fig. 6. 33 days old spat.

Fig. 7. 45 days old spat.

Settlement of the spat was noticed from 23rd day onwards and continued till the 27th day. Active growth of the spat was noticed after settlement and they grew to 5.9 mm in length by 60th day. The different stages of development are shown in Figs. 1–7.

The larvae were fed with the culture of *Isochrysis galbana* from the 2nd day onwards. The strength of the culture used for food was 2,000 cells/larvae in the earlier stages and gradually raised to 3,000 cells/larvae later. After 45 days, the spat were fed with mixed culture of *Chaetoceros, Coscinodiscus* and *Skeletonema*. Water was changed completely on every alternate day. Aeration was given only after the settlement of spat.

Details of the growth of larvae in length (measured from hinge/umbo to the edge of the shell), breadth (maximum measurement perpendicular to hinge/umbo) and height (maximum thickness of the shell) are given in Table 1.

A total of 20,500 spat of *Perna viridis* were obtained from the experiment. The production could be increased substantially by improvement of water quality and reducing the density of the larvae. The work shows that there are good possibilities for production of green mussel seed through hatchery techniques. Large scale production of spat of this economically important species will be of immense help in conducting mussel farming.

Abbreviation used

Cp	:	chromatophore pigments
e	:	eye
f	:	foot
gf	:	gill filaments
gl	:	growth lines
h	:	heart
hi	:	hinge
in	:	intestine
me	:	mantle edge
pa	:	posterior adductor muscle
sh	:	shell
si	:	siphon
ve	:	velum
vi	:	visceral mass
u	:	umbo

EXPERIMENTAL MOLLUSCAN SEED TRANSPORT*

Introduction

A priority area of attention under the R & D efforts of the Institute is the mass production of seed of cultivable marine fish and shellfishes and to make available the required quantity to the farmers and for 'ranching'. Investigations carried out during 1980–'86 in the shellfish hatchery at Tuticorin enabled mass production of the spat of pearl oyster *(Pinctada fucata)* and edible oyster *(Crassostrea madrasensis)* and also the standardization of technique for such mass production. Trials were conducted during 1985–'87 to evolve safe methods of seed transport, avoiding mortality in transit. The present communication outlines some of the procedures found effective in handling the seeds before, during and after subjecting them to long distant transport by road, sea or air.

I. Transportation of seed of pearl oysters

The pearl oyster spat are known to be highly susceptible to oxygen deficiency, and variations in temperature and salinity in the sea water. While planning the experimental transport, the following criteria were adopted.

a) Selection of the spat of the same batch
b) Conditioning of spat for 24 hrs in filtered sea water before packing
c) Ensuring constant sea water drip or bathing to keep the spat free from adverse effects arising out of variation in water temperature
d) Relieving stress that may result due to oxygen deficiency by adequate oxygenation
e) Refreshing the spat with fresh sea water in one or two stages during transport and on reaching the destination and
f) Devising easy methods of packing the spat.

---

*Prepared by A. Chellam, S. Dharmaraj, T. S. Velayudhan and P. Muthiah, Tuticorin Research Centre of CMFRI, Tuticorin.

Transport by sea

In December, 1985, 50,000 spat of the size 8.3 mm (35,000) and 24 mm (15,000) were taken by sea to the oyster farm at Krusadai, managed by Tamil Nadu Pearls Ltd. The distance covered was 80 nautical miles in 9 hrs.

The spat were uniformly spread in closely knit nylon meshed cages. The cages were arranged under shade on the deck of a mechanised boat. Care was taken to keep the spat always wet by sea water shower during the journey. The entire consignment reached the destination without any mortality. Subsequent monitoring of the survival and growth in the farm at Krusadai showed normal behaviour.

Transport by road and sea

In October 1986, 10,000 spat of size 3.7 mm (2,500) and 13.7 mm (7,500) were sent to Agatti in Lakshadweep. The distance covered was 400 km by road and 250 nautical miles by sea.

The spat were packed in leak-proof polythene bags, each bag containing 750 spat in 3,000 ml of filtered sea water. The bags were filled with oxygen and mouth tightly sealed. The bags were encased in tin containers. After 12 hrs of road journey, the spat were transferred into plastic basins with fresh sea water and aerated adequately. The basins with spat were transported by sea from Cochin. The basins were kept in shade maintaining constant change of sea water. There was no report of spat mortality during this attempt.

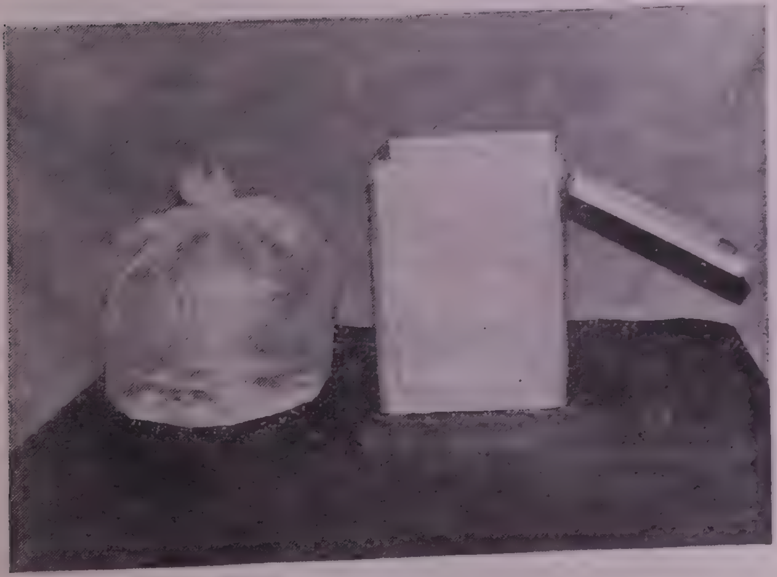


Fig. 1. Pearl oyster seed for road transport - in oxygen-filled polythene bag.

Transport by road and air

In May, 1987, 5,800 spat of size 10 mm (5,500) and 23 mm (300) were sent to Sikka in Gujarat. The first leg of the transport was by road upto Trivandrum covering a distance of 180 km and from there to Jamnagar *via* Bombay by air involving a distance of about 1,700 km. The total time involved in the transport was 33 hrs.

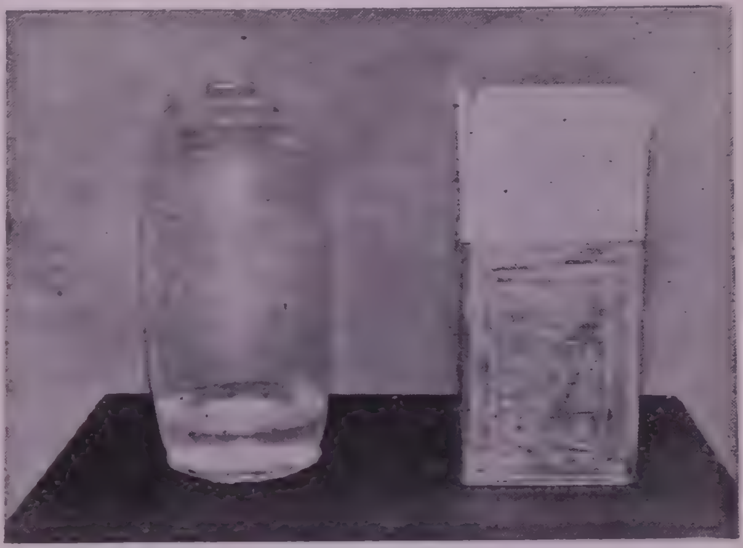


Fig. 2. Pearl oyster seed for air transport - in oxygen-filled heavy-duty fish transport bag.

The spat were transported by road in wet condition. At Trivandrum, they were kept in basins containing fresh sea water and aerated overnight. Heavy-duty polythene fish seed transport bags were used to carry the spat by air. Five hundred spat were put in each bag containing 4,000 ml of filtered sea water. Oxygen was filled to capacity and mouth tightly closed. The bags were wrapped with wet cotton wool and lowered into retrievable polythene bags. These bags were put in tin containers with sides lined with thermocol. Each tin had a lid also. These extra measures were taken because the transport of the spat was done during the peak summer month when atmospheric temperature had exceeded 36°C and water temperature 33°C. A mortality of 14.5% was reported at the end of the transport of spat at Sikka.

II. Transportation of seed of edible oysters

Lot of useful information are available on the transportation of seed of edible oysters from countries like Japan and United States. These seed are known to be more hardy and if subjected to 'hardening' prior to transport, they are known to survive the transit period very well. Hence, while planning the transport of edible oyster seed from Tuticorin the above fact was given due importance. Where the process of hardening was not adhered to, the percentage of mortality of spat after reaching destination was found to be fairly high. Wet packing of the seed was found to be economical as well as efficient while transporting. Packed in this way the oyster seeds were kept alive even upto 90 hrs. The following experiments were conducted during 1981–'87 to find out the satisfactory transport method.

Transport by road

250 oyster seed of size 30–40 mm were sent to Madras by road. Hardening was done for 10 days prior to transportation. The seeds were wrapped in gunny sheet soaked in sea water and put in a box type cage 40 x 40 x 10 cm size with nylon meshes. After 17 hrs of road journey covering a distance of 650 km, the consignment reached Madras, and the percentage of mortality of the seed was 0.4 only.

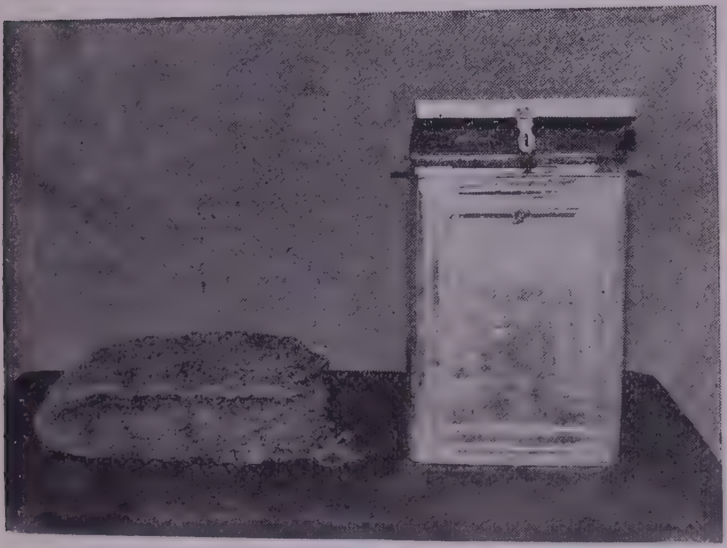


Fig. 3. Hardened edible oyster seed wrapped in wet gunny sheet ready for transportation.

In another experiment 2,000 spat of size 15–20 mm were transported to Narakkal by road, covering a distance of 470 km in 15 hrs following identical procedure. No mortality was observed during transportation.

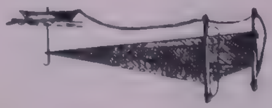
Transport by road and air

In 1987, 5,800 spat of size 10–20 mm were sent to Sikka in Gujarat State, involving road transport initially for a period of 6 hrs from Tuticorin to Trivandrum followed by air lift to Jamnagar *via* Bombay, involving a duration of 33 hrs.

The oyster seed wrapped by gunny sheet soaked in sea water were kept in tin containers (9 nos). This was to facilitate easy handling of the consignment at the time of loading in the plane. At the end of the road transport period, the seed were emptied into plastic basins containing fresh sea water prior to repacking them as before. This process was followed so that it would enable the seed to remain fresh during the aerial transport period.. Very little mortality occurred during the transit.

Acknowledgements

It would not have been possible for us to carry out the above experiments but for the co-operation extended by the Director, Department of Fisheries, Gujarat; the Director, Department of Fisheries, Union Territory of Lakshadweep and the Managing Director, Tamil Nadu Pearls Ltd. In this context the assistance and help rendered by Shri C. G. Koya, Department of Fisheries, Lakshadweep and Shri K. A. Pota, Department of Fisheries, Gujarat are gratefully acknowledged.



A RECORD CATCH OF 'GHOL' *PROTONIBEA DIACANTHUS* (LACEPEDE) OFF SATPATI, BOMBAY COAST*

Protonibea diacanthus (Lacepede), called 'ghol' in Bombay, is a commercially very important sciaenid forming 5 to 8 per cent of the trawler landings from the Bombay and Saurashtra waters. Being demersal in habitat 'ghol' is usually landed by trawlers, bagnetters and gillnetters. The 'ghol' fishery was considered to

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*Reported by J. P. Karbhari, J. R. Dias and M. Aravindakshan, Bombay Research Centre of CMFRI, Bombay.

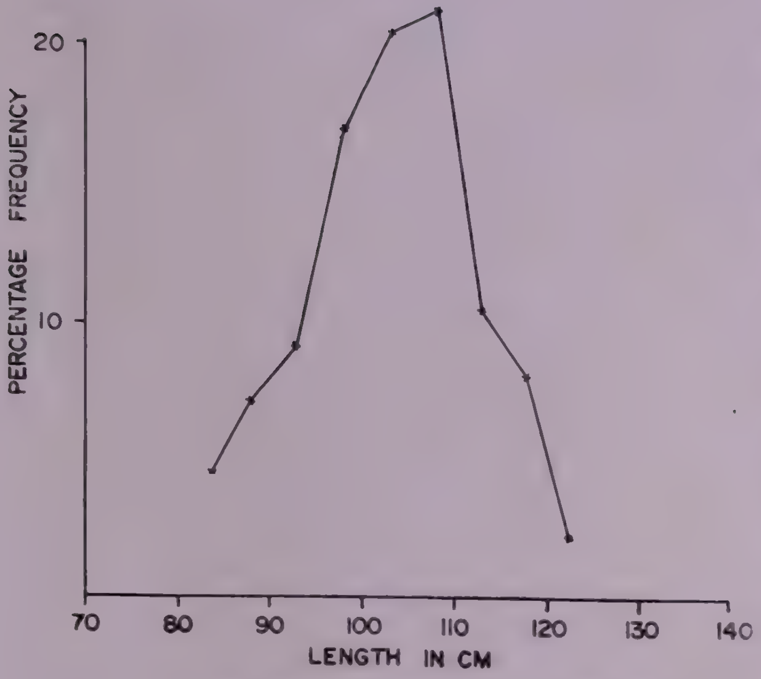

Fig. 1. Length frequency polygon of *P. diacanthus.*

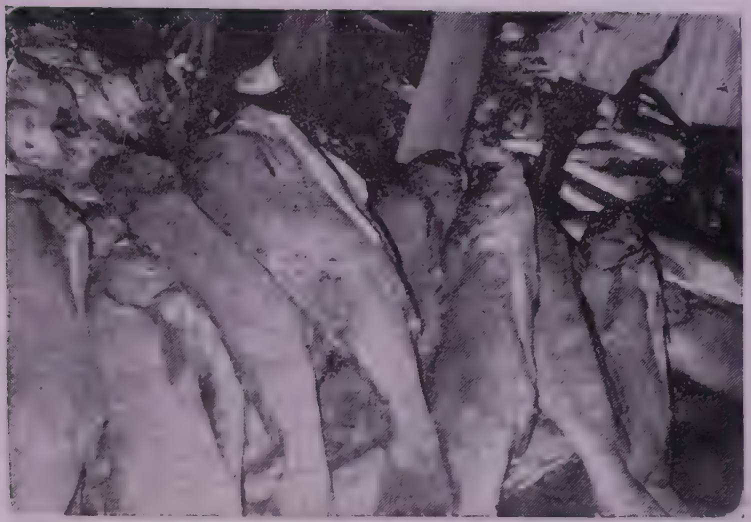

Fig. 2. A view of the bulk of 'Ghol' catch auctioned at fish market at Bombay.

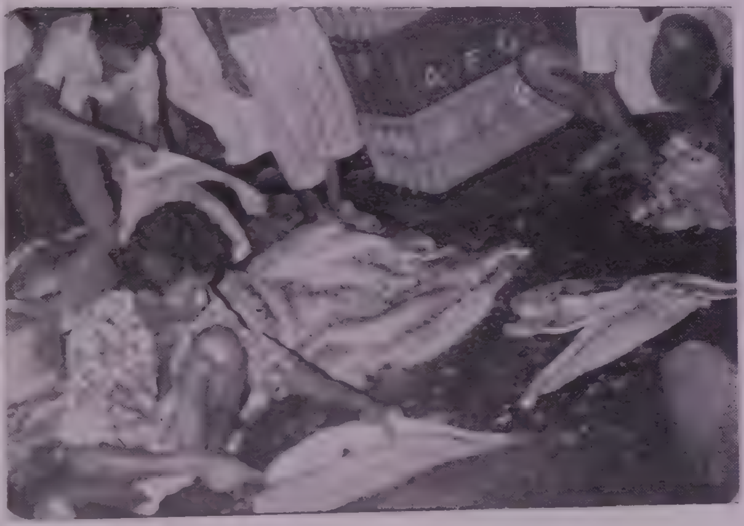

Fig. 3. 'Ghol' being filleted at fish market at Bombay.

be highly lucrative in the Bombay region until early Seventies. The fishery has been found sharply declining from mid-seventies in the area. In the present note the details of a record catch of 'ghol' consisting of 3,218 specimens, weighing approximately 39.52 tonnes, caught in a single haul of 'dol' net laid in 30 m depth off Satpati (Bombay coast) are presented.

In the early morning on 14th November, 1986 a 32-footer mechanised 'dolnetter' (locally called 'dolkar') steamed out for fishing. On locating its 'Sus' or 'Kav' ('dol' net operating stand) two 'dol' nets were laid at about 1300 hrs in 30 m depth off Satpati. On encountering great difficulties by twelve crew members of the boat in hauling in the nets at about 1730 hrs, assistance of two other boats, fishing nearby, was sought and the prized catch of 'ghol' was brought ashore in two boats. The entire catch was then transported to the wholesale fish market (Shivaji Market) at Bombay, where it was auctioned for a lucrative price of Rs. 2.5 lakhs. The fish was filleted and processed for local and export markets.

A sample of 88 specimens was measured at the Shivaji Market and the size was found to range from 85 to 121 cm. The average length of the fish was found to be 99.80 cm and the average weight 12.28 kg. The dominant mode was at 108 cm. The length-frequency distribution of the various size groups in the catch is presented graphically (Fig. 1).

An analysis of the stomach contents of 35 specimens at the market revealed semi-digested remnants of Horse mackerel *(Megalaspis cordyla)*, Golden anchovy *(Coilia dussumieri)*, Malabar sole *(Cynoglossus macrostomus)* and croakers *(Sciaena* spp.*)*. Most of the specimens had extroverted stomachs (70%) a characteristic feature of 'ghol'.

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MARINE FISHERIES INFORMATION SERVICE

8/9/89

No. 80
FEBRUARY 1988

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Abbreviation – *Mar. Fish. Infor. Serv., T & E Ser.,* No. 80: 1988

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3. Unusual fishery for oil sardines along the West Saurashtra Coast

4. *Acetes* shrimp fishery of Bombay Coast

Front cover photo:

Catamaran setting out on sail.

Back cover photo:

A view of the Visakhapatnam Fisheries Harbour.

MARINE FISH CALENDAR

2. VISAKHAPATNAM

G. Luther, T. Appa Rao, S. Reuben, Y. Appanna Sastry, M. V. Somaraju, C. Gopal and K. Radhakrishna

Visakhapatnam Research Centre of CMFRI, Visakhapatnam

Introduction

This fish calendar has been prepared to furnish information on the important families (*e.g.* Clupeidae, Scombridae, Sciaenidae, *etc.*), groups (*e.g.* sardines, mackerel, croakers, *etc.*) and species of fishes that are met with in the commercial fish landings of both the artisanal and mechanised sectors, together with such other details as would help those who wish to acquire some knowledge of the general features of the fish and fisheries of the Visakhapatnam area. Details furnished for each group include the vernacular name, popular English name and gearwise annual average landings together with percentage composition in the total landings by the same gear. For the dominant species of a group caught in each gear, their relative composition, local names wherever available, length range, dominant size, depth of capture, size at first maturity and spawning seasons are also given.

Data collected by the Research Centre during recent years (1981–'86) have been used for this purpose. The data of corresponding months of the period have been pooled. Seasonal trends depicted by kite-diagrams, and species composition by bar-diagrams are presented separately for each group of fish landed by the major gears: shrimp trawl, gill net, and all other indigenous gears put together (*e.g.* shore seine, boat seine, hooks and line, *etc.*). Catch per hour of trawling (CPH or C/E) for shrimp trawl, and catch per net per day (C/U) for indigenous gears have been used as indices of abundance for furnishing the monthly trends of fish catches. Figures have been provided for important species of fishes to facilitate their recognition.

Forty-two species of fishes belonging to nineteen groups and sixteen families have been included in this fish calendar, besides sharks, skates and rays which have been presented under a single category – group Elasmobranchs.

A composite picture of the fish and fisheries of the Visakhapatnam area is also given here to enable the reader to make a proper appraisal of the fishery of the groups/species of fishes presented in the calendar and for their effective exploitation and utilization.

The fisheries canvas of Visakhapatnam is a mosaic of artisanal fishing carried out within 8–10 km from shore by a variety of indigenous gears from country crafts, and of mechanized fishing by shrimp trawls carried out in deeper waters by 200 odd small mechanized boats and by about 30 mini and 100 large trawlers. The range of operation of the small mechanised boats extends upto 50 km north-south and 15 km off the coast of Visakhapatnam making fishing trips lasting for 1–3 days each, while the mini and large trawlers fish mostly in the Gopalpur–Sandheads area making longer voyages lasting for 10–30 days. The country

20
16
12
8
VISAK HA PATNAM
72
80
88

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*Consolidated by N. Gopinatha Menon and K. Balachandran, CMFRI, Cochin.

crafts and the small mechanised boats land almost all of their catches whereas the mini and large trawlers land mostly shrimp, discarding the fish at sea. With this multi-faceted fishing activity, supported by a modern fisheries harbour with adequate infrastructure built around it, Visakhapatnam has emerged as the capital of deep sea fishing industry of the country.

Lawson's Bay is the major artisanal fish landing centre of Visakhapatnam. Of late, another area close to the Visakhapatnam fishing harbour is developing into an important artisanal fish landing centre because of the fast developing marketing facilities in its vicinity. The annual average fish landings at these two centres are around 680 and 500 t respectively. Year-round fishing activity is noticeable at these two centres. Fishing effort by the artisanal sector in general is intense during February–April followed by June–July. It is quite low during November–January. Catch rates are better during April–June and December–February. However, bulk of the annual fish catch is obtained during February–August.

Hooks and lines and bottom-set gill nets (silk vala) are the main gears employed by the fishermen operating from the three adjacent fishing villages of the Lawson's Bay landing centre, namely, Jalaripeta, Vasavanipalem and Moolapalem, while gill nets and boat seines are the major gears used by the fishermen operating from the other landing centre Kotha Jalaripeta near fisheries harbour. The average catch per unit (C/U) for the different gears are: hooks and line 10 kg, bottom-set gill net 20 kg, gill net 40 kg and boat seine 50 kg. While shore-seine is operated during October–May, the rest of the gears are operated round the year. However, intensity of their operations is as follows: hooks & lines from December to August, bottom-set gill nets from May to September, gill nets from November to July and boat seines from August to February.

The important groups of fishes met with in the artisanal fish landings are: seer fishes 18%, tunas and bill fishes 13%, mackerel 13%, sardines 11%, cat fishes 9%, jacks 7%, whitebait anchovy 5%, sharks 5%, ribbon fishes 4%, rainbow sardine 2%, silver bellies 2% and bulls eye 1%. The important groups caught in the different gears and their species composition are given in the fish calendar.

Mechanised fishing by small boats is also carried out throughout the year. All the boats go for daily day – fishing trips during March – October. During November–February, about 75-80% of these boats goes for either daily night or stay fishing. In the latter two cases the boats leave in the evening and fish that night, or stay at sea and fish on the following day and night, and return to the base in the morning. During all these trips three hauls each of two hours duration are made during the day, and of three hours duration at night. Thus during the course of a single trip a boat expends about six hours of actual fishing effort in daily day-fishing, nine hours during daily night-fishing, and about 24 hours during stay-fishing.

Over the five year period (1981–'85) monthly trawling effort ranged between 14,117 hrs and 28,622 hrs with the average at 22,886 hrs, monthly fish landings ranged between 361 and 814 t with the average at 525 t and the catch rate ranged between 17 kg/hr and 29 kg/hr with the average at 23 kg/hr. With reference to these average figures, fishing effort was better during July–January, total fish catches during July–October and catch rates during July–September and February–May. Thus both total catches as well as catch rates were better during July–September and this is considered as the best period for the trawl fishery off Visakhapatnam.

Eight groups of fishes form the bulk (68%) of trawler landings. They are threadfin breams 13.5%, prawns 13%, lizard fishes 9.7%, croakers 7.7%, ribbon fishes 7.4%, silver bellies 5.9%, crabs 5.5% and goat fishes 4.9%. Six other groups account for about 17% of the annual catches. They are jacks 3.3%, bulls eye 3.4%, squids and cuttle fishes 3.1%, whitebait and thryssa anchovies 3.0%. The rest of the catch comprises of a variety of small sized fishes.

CARANGIDAE

Popular English Name : Jacks/Trevallies/Scads/Horse mackerels
Vernacular Name (Telugu) : 'Paralu'
Annual average catch : 304 t
Gearwise annual average catch : Trawl net : 249 t
Drift gill net : 25 t
Shore seine and hooks & line : 30 t
Fishing methods and their contribution in the gears : Drift gill net : 14%
Shore seine and hooks & line : 7%
Trawl net : 4%

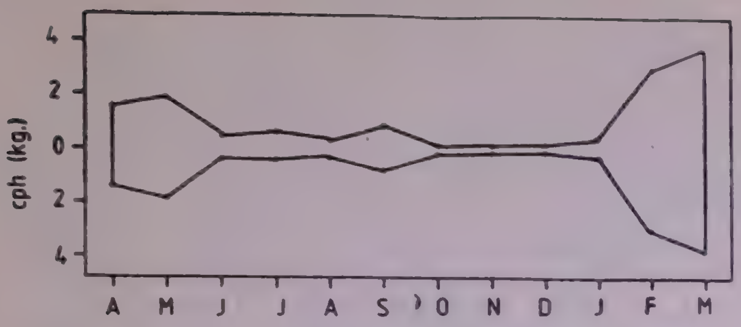


Fig. 1. Seasonal abundance of jacks (gear: shrimp trawl).

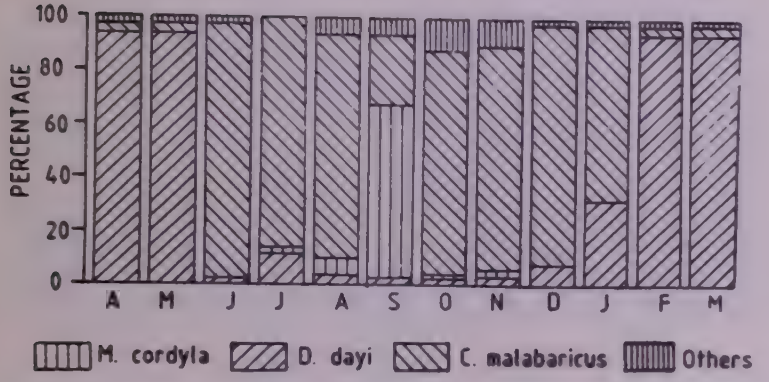


Fig. 2. Monthly species composition of jacks landed by shrimp trawls.

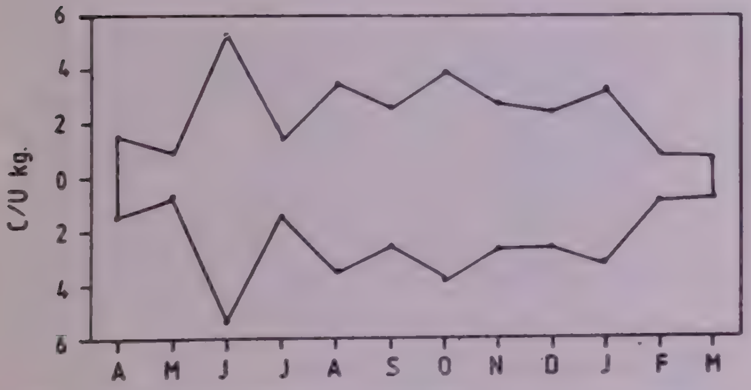


Fig. 3. Seasonal abundance of jacks (gear: gill nets).

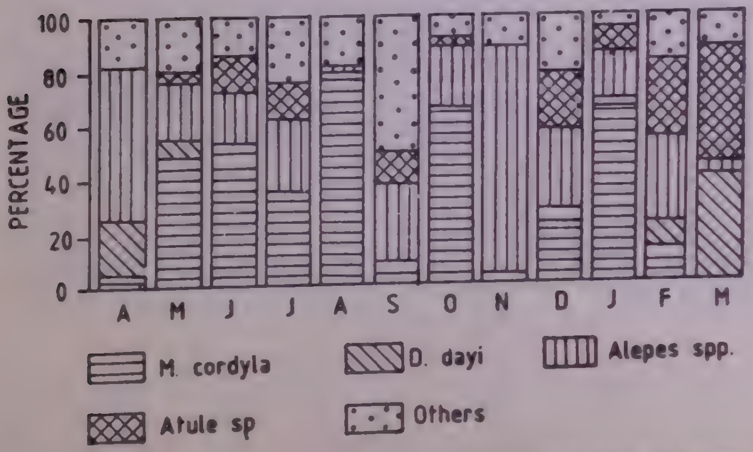


Fig. 4. Monthly species composition of jacks landed by gill nets.

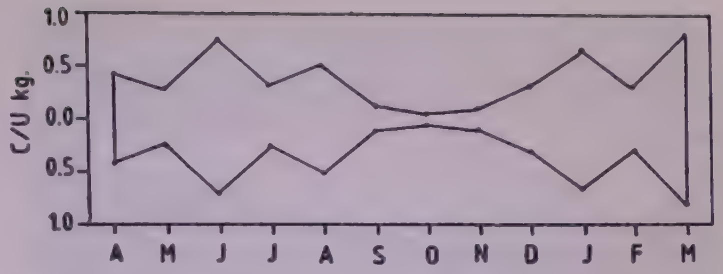


Fig. 5. Seasonal abundance of jacks (gear: other indigenous gears).

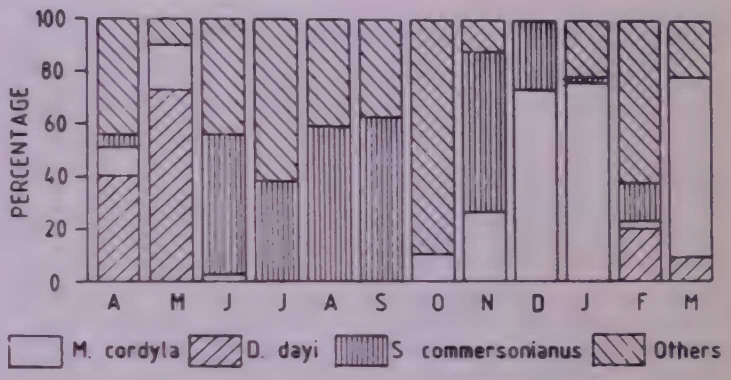


Fig. 6. Monthly abundance of jacks landed by indigenous gears.

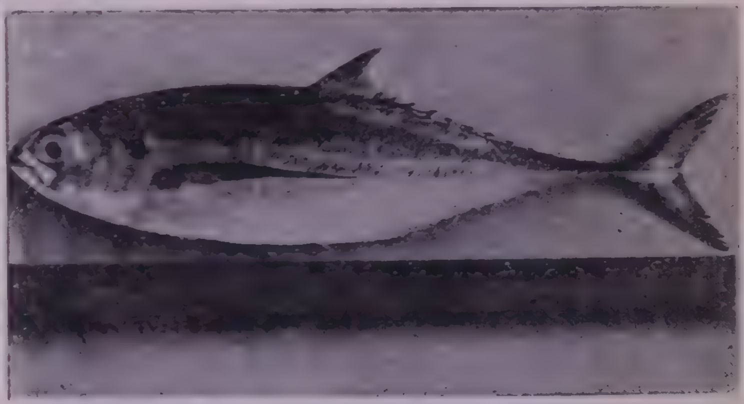


Fig. 7. *Megalaspis cordyla.*

Scientific Name : *Megalaspis cordyla*
Vernacular Name : 'Bokkodugu'
Gear : Drift net
Percentage in the catch of the group : Drift net : 44
Peak period of occurrence : July-January
Depth of occurrence : 20-40 m
Length range in commercial fishery : 175-440 mm
Size at first maturity : 240 mm
Spawning season : March-April

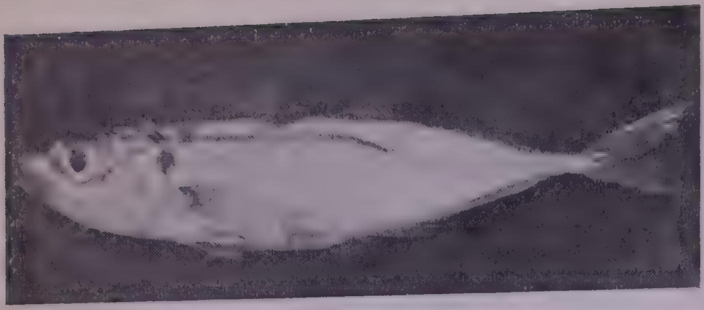


Fig. 8. *Decapterus dayi.*

Scientific Name	:	*Decapterus dayi*
Vernacular Name	:	'Pillodugu'
Gear	:	Shore seine/Hooks & line/Trawl net
Percentage in the catch of the group	:	Shore seine and hooks & line : 27 Trawl net : 72
Peak period of occurrence	:	January–May
Depth of occurrence	:	1–60 m
Length range in commercial fishery	:	30 – 234 mm
Size at first maturity	:	120 – 130 mm
Spawning season	:	February – March

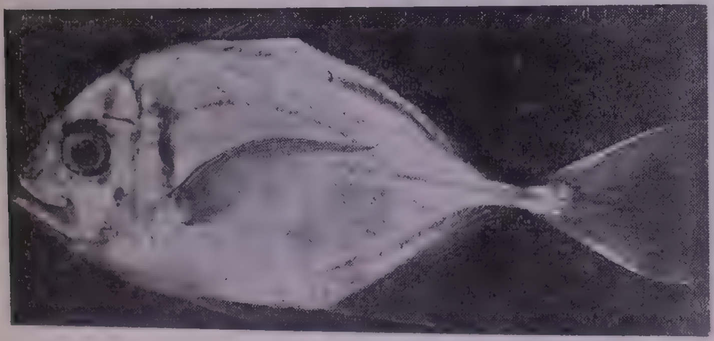


Fig. 9. *Carangoides malabaricus.*

Scientific Name	:	*Carangoides malabaricus*
Vernacular Name	:	'Thalampara'
Gear	:	Trawl net
Percentage in the catch of the group	:	Trawl net : 20
Peak period of occurrence	:	June-January
Depth of occurrence	:	10-60 m
Length range in commercial fishery	:	110 – 270 mm
Size at first maturity	:	150 mm
Spawning season	:	March

CLUPEIDAE

Popular English Name	:	Sardines		
Vernacular Name (Telugu)	:	'Kavvallu'		
Annual average catch	:	283 t		
Gearwise annual average catch	:	Gill net	:	146 t
		Boat seine	:	137 t
Fishing methods and their contribution in the gears	:	Gill net	:	90%
		Boat seine	:	47%

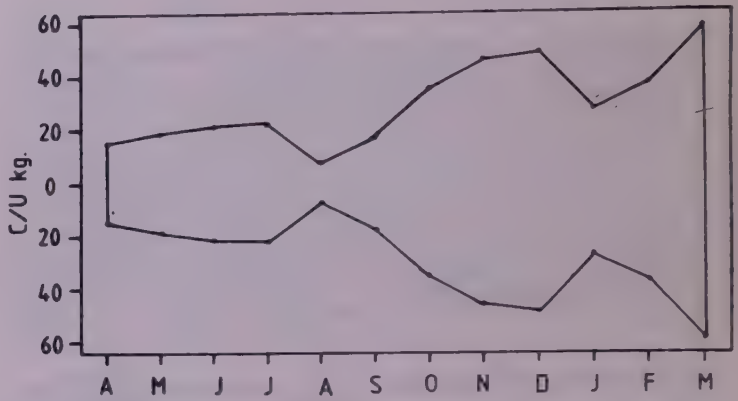


Fig. 10. Seasonal abundance of sardines (gear: gill net).

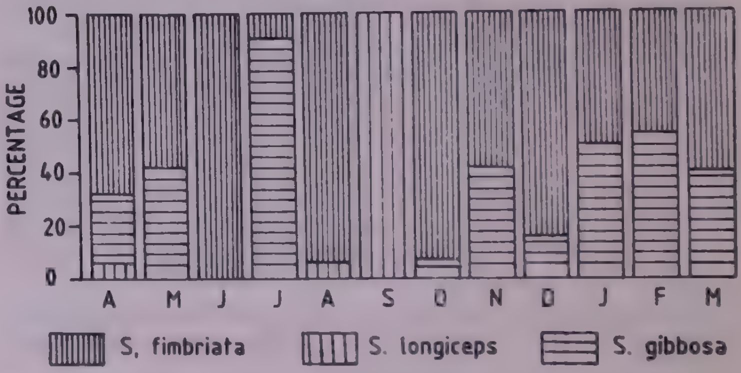


Fig. 11. Monthly species composition of sardines landed by gill nets.

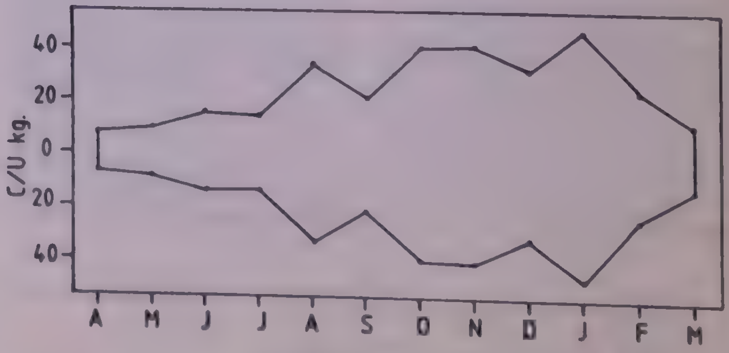


Fig. 12. Seasonal abundance of sardines (gear: other indigenous gears).

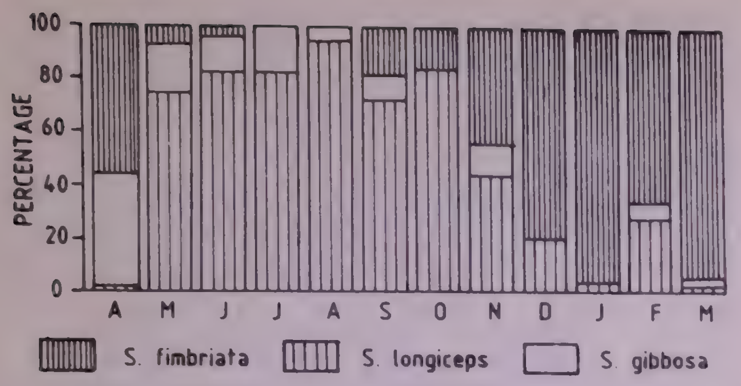


Fig. 13. Monthly species composition of sardines landed by other indigenous gears.

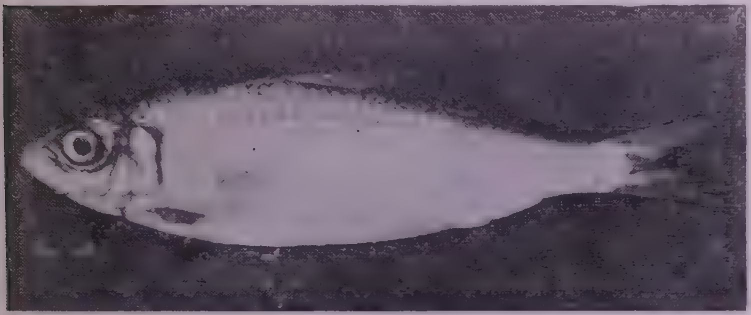


Fig. 14. *Sardinella fimbriata.*

Scientific Name : *Sardinella fimbriata*
Vernacular Name : 'Balla kavvallu'
Gear : Gill net/Boat seine
Percentage in the catch of the group : Gill net : 66
Boat seine : 46
Peak period of occurrence : October–March
Depth of occurrence : 10 - 20 m
Length range in commercial fishery : 40 – 195 mm
Size at first maturity : —
Spawning season : July – August

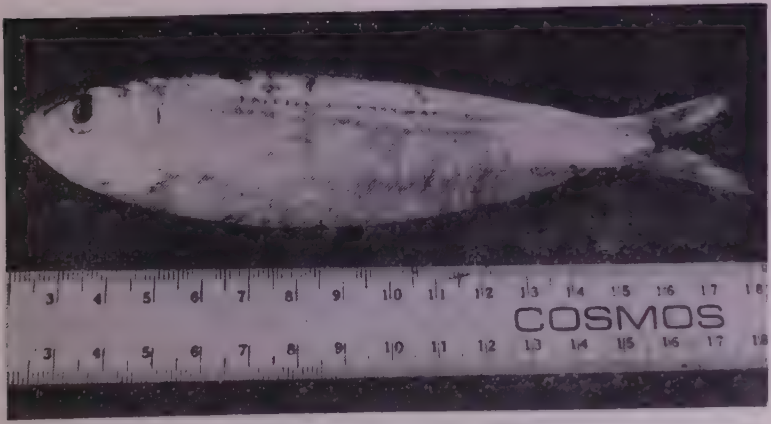


Fig. 15. *Sardinella gibbosa.*

Scientific Name : *Sardinella gibbosa*
Vernacular Name : 'Soodimooti kavvallu'
Gear : Gill net/Boat seine
Percentage in the catch of the group : Gill net : 33
Boat seine : 46
Peak period of occurrence : November – March
Depth of occurrence : 10 – 20 m
Length range in commercial fishery : 35 – 180 mm
Size at first maturity : 120 mm
Spawning season : January – May

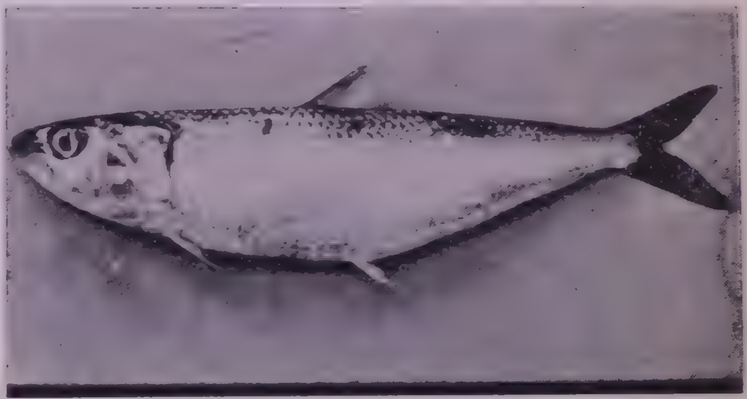


Fig. 16. *Sardinella longiceps.*

Scientific Name : *Sardinella longiceps*
Vernacular Name : 'Noone kavvallu'
Gear : Gill net/Boat seine
Percentage in the catch of the group : Boat seine : 48
Gill net : 1
Peak period of occurrence : August – November
Depth of occurrence : 10 – 20 m
Length range in commercial fishery : 40 – 205 mm
Size at first maturity : 150 mm
Spawning season : June – September

ELASMOBRANCHS

Popular English Name : Sharks and Skates
Vernacular Name (Telugu) : 'Sorralu'/'Adalam'/'Yalam'
Annual average catch : 55.7 t
Gearwise annual average catch : Hooks & line : 34.9 t
Trawl net : 20.8 t
Fishing methods and their contribution in the gears : Hooks & line : 10.4%
Trawl net : 0.3%

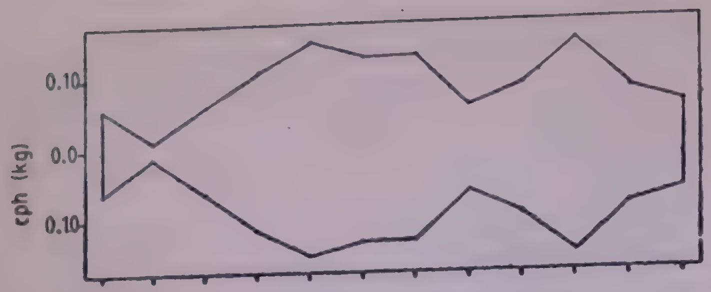


Fig. 17. Seasonal abundance of elasmobranchs (sharks & skates) in trawl nets.

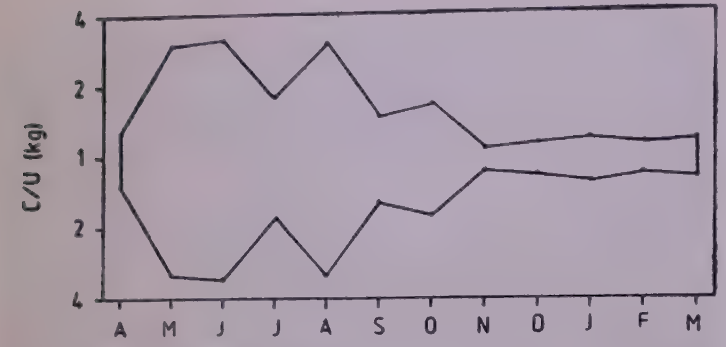


Fig. 18. Seasonal abundance of elasmobranchs (sharks & skates). in hooks and line.

ELASMOBRANCHS

Popular English Name : Rays
Vernacular Name (Telugu) : 'Tekulu'
Annual average catch : 60.8 t
Gearwise annual average catch : Trawl net : 60.8 t
Fishing methods and their contribution in the gears : Trawl net : 1%

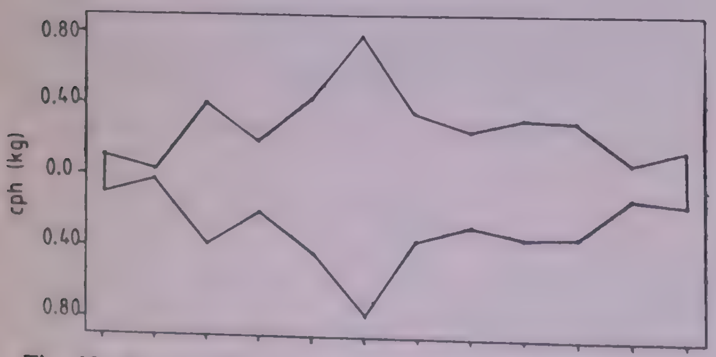


Fig. 19. Seasonal abundance of elasmobranchs (rays) in trawl nets.

ENGRAULIDAE

Popular English Name : Anchovies/Whitebait
Vernacular Name (Telugu) : 'Nethallu'
Annual average catch : 176 t

Gearwise annual average catch : Trawl net : 132 t
Shore seine : 40 t
Boat seine : 4 t

Fishing methods and their contribution in the gears : Shore seine : 60%
Boat seine : 3%
Trawl net : 1.9%

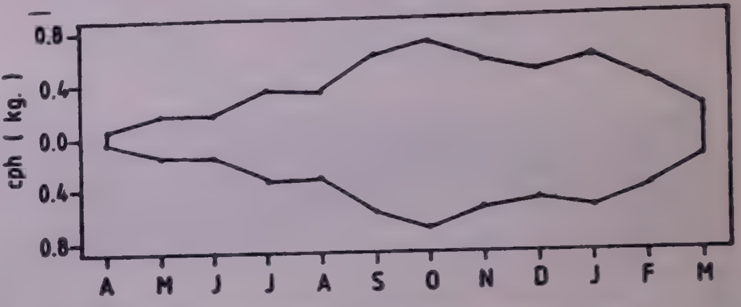


Fig. 20. Seasonal abundance of whitebait anchovy (gear: shrimp trawls).

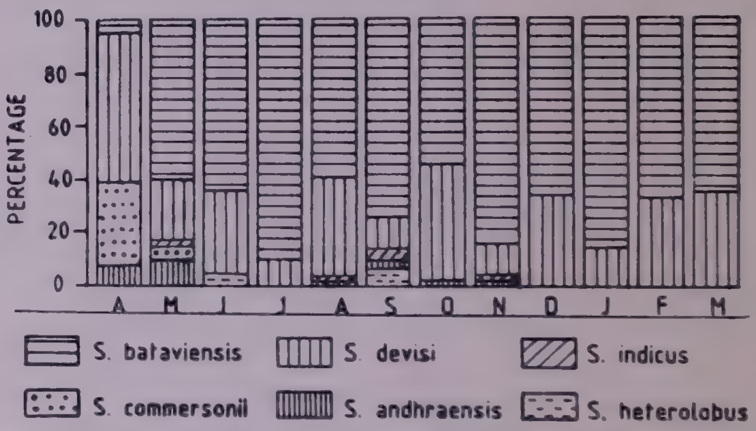


Fig. 21. Monthly species composition of whitebait anchovy landed by shrimp trawls.

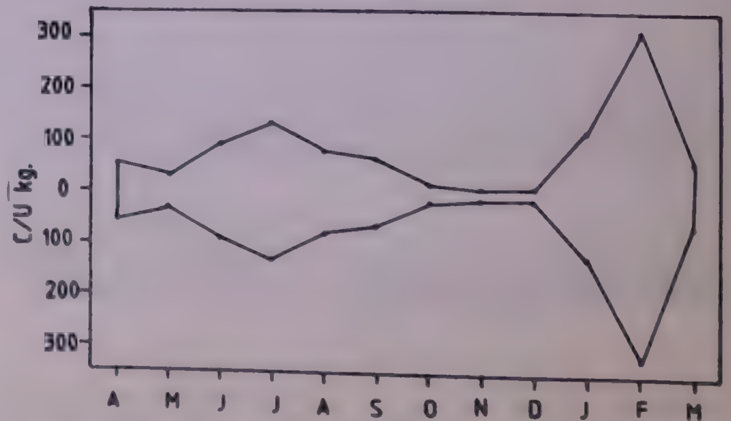


Fig. 22. Seasonal abundance of whitebait anchovy (gear: other indigenous gears).

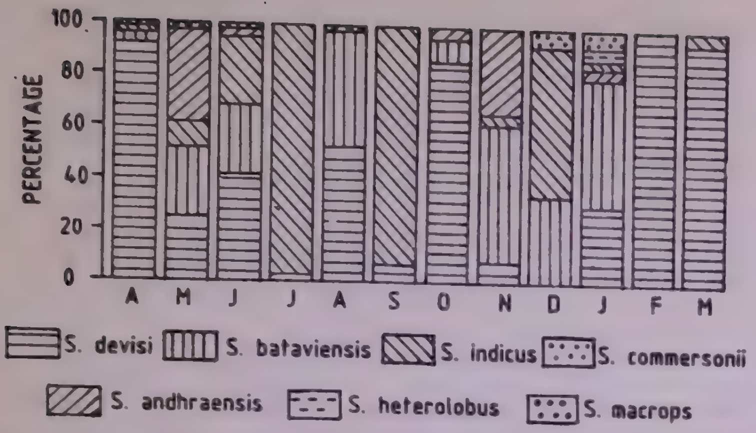


Fig. 23. Monthly species composition of whitebait anchovy landed by other indigenous gears.

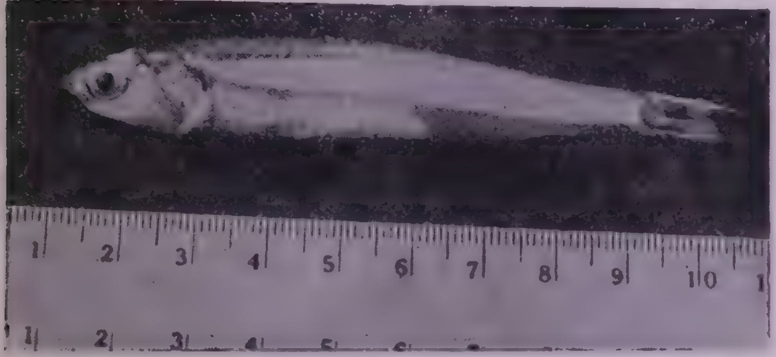


Fig. 24. *Stolephorus devisi.*

Scientific Name : *Stolephorus devisi*
Vernacular Name : 'Namala nethallu'
Gear : Trawl net/Shore seine/ Boat seine
Percentage in the catch of the group : Trawl net : 26
Shore seine : 95
Boat seine : 39
Peak period of occurrence : August – May
Depth of occurrence : 10 – 20 and 40–60 m
Length range in commercial fishery : 30 – 95 mm
Size at first maturity : 60 – 64 mm
Spawning season : February – March, June – August and October – December

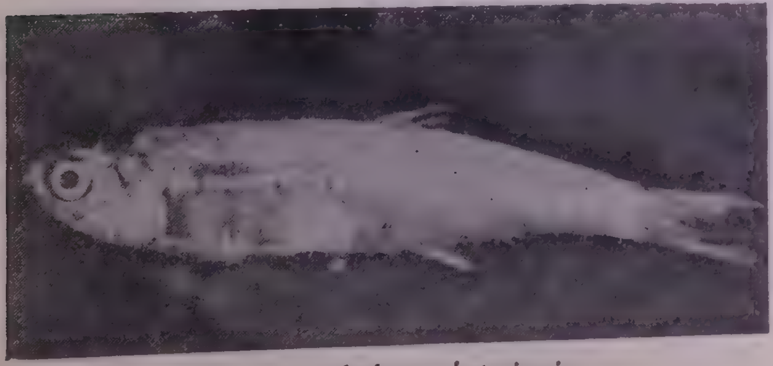


Fig. 25. *Stolephorus bataviensis.*

Scientific Name : *Stolephorus bataviensis*
Vernacular Name : 'Balla nethallu'
Gear : Trawl net/Shore seine/ Boat seine
Percentage in the catch of the group : Trawl net : 70
Shore seine : 3
Boat seine : 6
Peak period of occurrence : September – January
Depth of occurrence : 10–20 and 40 – 60 m
Length range in commercial fishery : 35 – 133 mm
Size at first maturity : 80 – 84 mm
Spawning season : February – March, June – July and Dec.

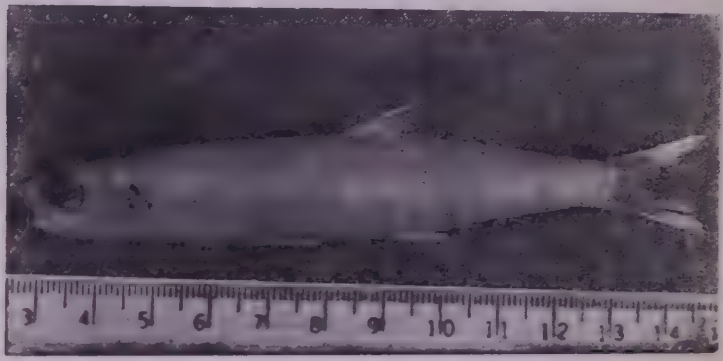


Fig. 26. *Stolephorus indicus.*

Scientific Name : *Stolephorus indicus*
Vernacular Name : 'Nethallu'
Gear : Boat seine
Percentage in the catch of the group : Boat seine : 22
Peak period of occurrence : April – September
Depth of occurrence : 10 - 20 m
Length range in commercial fishery : 45 – 160 mm
Size at first maturity : —
Spawning season : —

ENGRAULIDAE

Popular English Name : Thryssa anchovy
Vernacular Name (Telugu) : 'Poravalu'
Annual average catch : 71 t
Gearwise annual average catch : Trawl net : 71 t
Fishing methods and their contribution in the gears : Trawl net : 1%

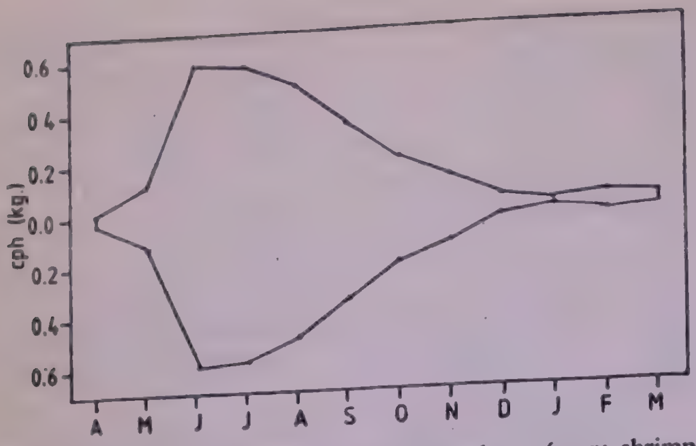


Fig. 27. Seasonal abundance of thryssa anchovy (gear: shrimp trawls).

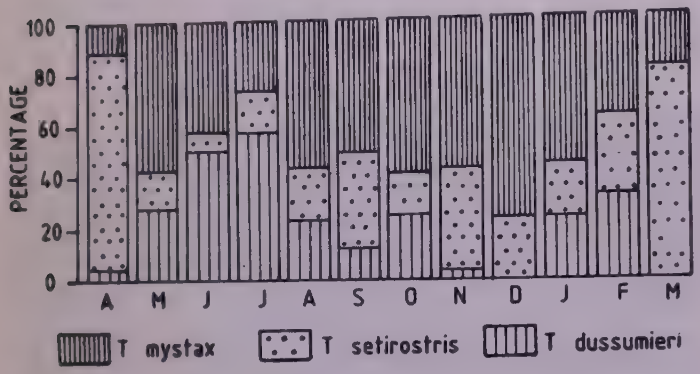


Fig. 28. Monthly species composition of thryssa anchovy landed by shrimp trawls.

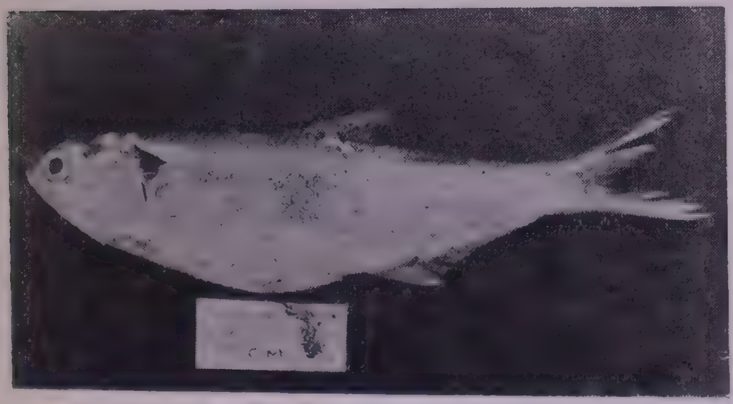


Fig. 29. *Thryssa mystax.*

Scientific Name : *Thryssa mystax*
Vernacular Name : 'Palli porava'/ 'Nedum porava'
Gear : Trawl net
Percentage in the catch of the group : Trawl net : 46
Peak period of occurrence : June – October
Depth of occurrence : 40 – 60 m
Length range in commercial fishery 65 – 220 mm
Size at first maturity : —
Spawning season : —

Scientific Name : *Thryssa dussumieri*
Vernacular Name : 'Potta porava'
Gear : Trawl net
Percentage in the catch of the group : Trawl net : 33
Peak period of occurrence : June - August
Depth of occurrence : 40 – 60 m
Length range in commercial fishery : 70 – 150 mm
Size at first maturity : —
Spawning season : —

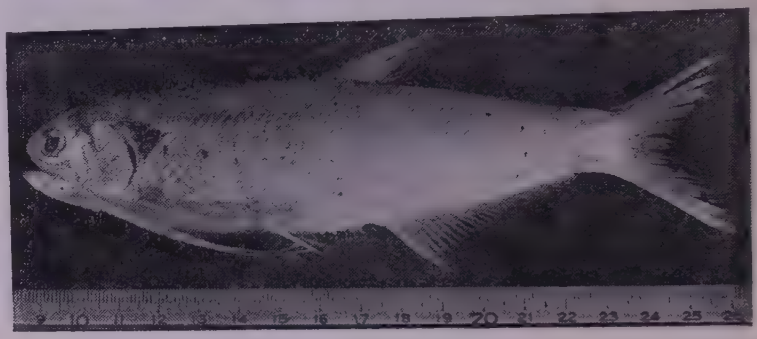


Fig. 30. *Thryssa setirostris.*

Scientific Name : *Thryssa setirostris*
Vernacular Name : 'Geddam porava'/'Yeeka porava'
Gear : Trawl net
Percentage in the catch of the group : Trawl net : 21
Peak period of occurrence : July – September
Depth of occurrence : 40 – 60 m
Length range in commercial fishery : 80 – 195 mm
Size at first maturity : —
Spawning season : —

ISTIOPHORIDAE

Popular English Name : Sail fish
Vernacular Name (Telugu) : 'Kommu konemu'
Annual average catch : 22.8 t
Gearwise annual average catch : Hooks & line : 22.8 t
Fishing methods and their contribution in the gears : Hooks & line : 7%

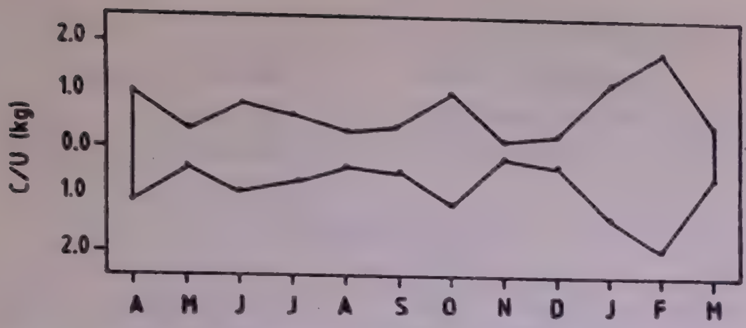


Fig. 31. Seasonal abundance of sail fishes (gear: indigenous gears).

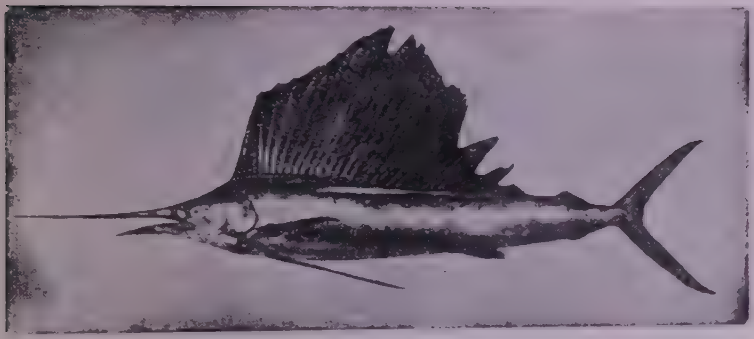


Fig. 32. *Istiophorus platypterus.*

Scientific Name : *Istiophorus platypterus*
Vernacular Name : 'Kommu konemu'
Gear : Hooks & line
Percentage in the catch of the group : Hooks & line : 100
Peak period of occurrence : January – April
Depth of occurrence : 30 – 60 m
Length range in commercial fishery : 1,500 – 1,700 mm
Size at first maturity : —
Spawning season : —

LACTARIIDAE

Popular English Name : Big jawed jumper/ White fish
Vernacular Name (Telugu) : 'Sudumulu'
Annual average catch : 74.5 t
Gearwise annual average catch : Trawl net : 74.5 t
Fishing methods and their contribution in the gears : Trawl net : 1%

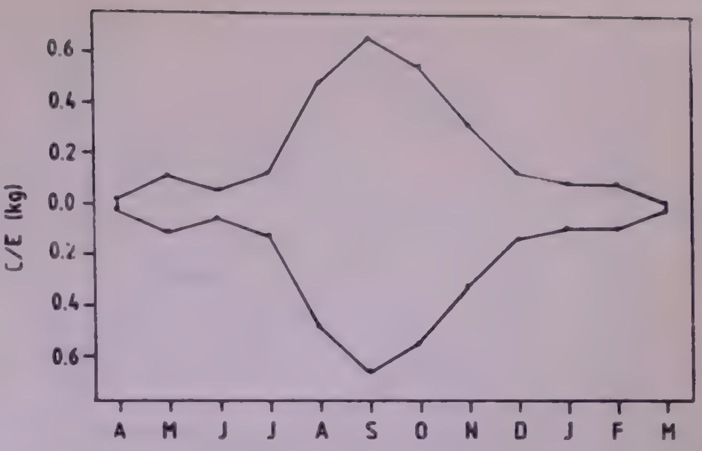


Fig. 33. Seasonal abundance of white fish (gear: indigenous gears).

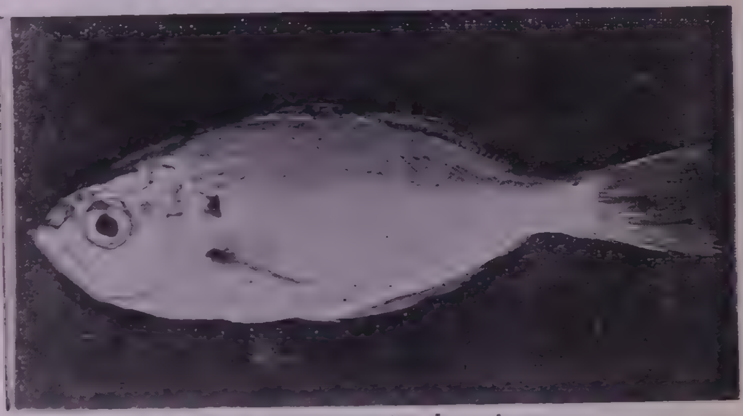


Fig. 34. *Lactarius lactarius.*

Scientific Name : *Lactarius lactarius*
Vernacular Name : 'Sudumulu'
Percentage in the catch of the group : Trawl net : 100
Peak period of occurrence : July – December
Depth of occurrence : 10 – 60 m
Length range in commercial fishery : 45 – 250 mm
Size at first maturity : 150 mm
Spawning season : March – April

LEIOGNATHIDAE

Popular English Name : Silver bellies
Vernacular Name (Telugu) : 'Karalu'
Annual average catch : 450 t
Gearwise annual average catch : Trawl net : 450 t
Fishing methods and their contribution in the gears : Trawl net : 5.7%

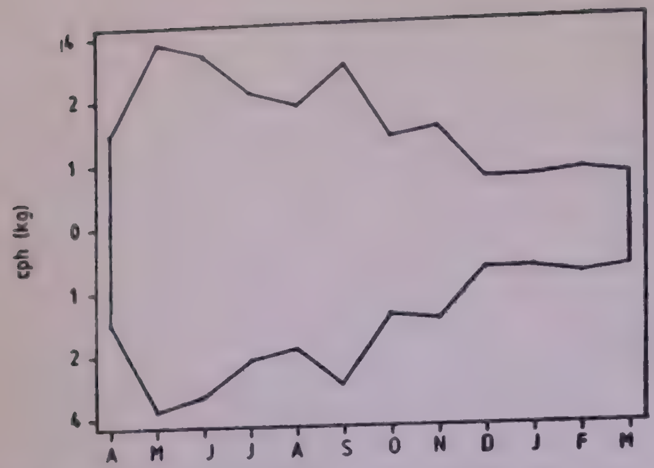


Fig. 35. Seasonal abundance of silver bellies (gear: shrimp trawls).

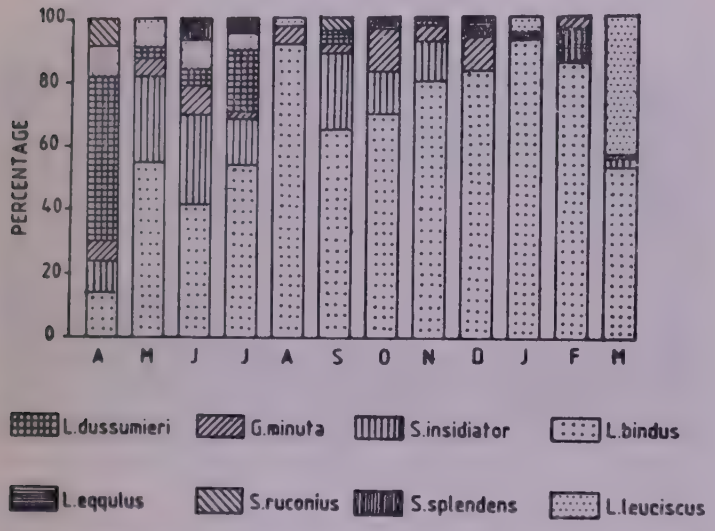


Fig. 36. Monthly species composition of silver bellies landed by shrimp trawls.

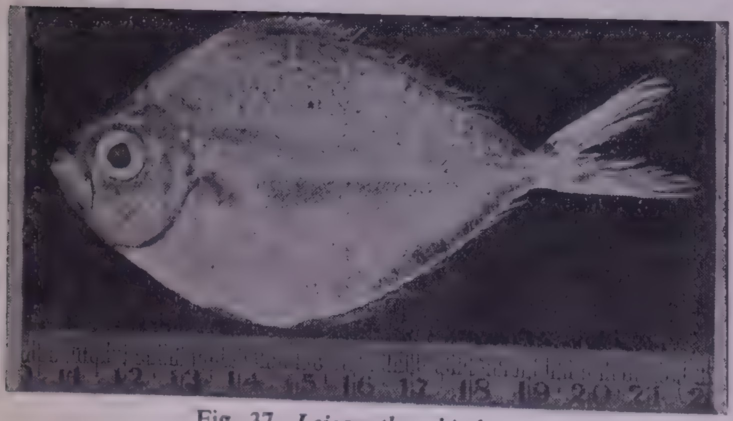


Fig. 37. *Leiognathus bindus*.

Scientific Name	:	*Leiognathus bindus*
Vernacular Name	:	'Karalu'
Gear	:	Trawl net
Percentage in the catch of the group	:	69
Peak period of occurrence	:	May – September
Depth of occurrence	:	10 – 50 m
Length range in commercial fishery	:	20 – 129 mm
Size at first maturity	:	80 mm
Spawning season	:	December – February

MULLIDAE

Popular English Name	:	Goat fishes
Vernacular Name (Telugu)	:	'Gulivindalu'
Annual average catch	:	441 t
Gearwise annual average catch	:	Trawl net : 441 t
Fishing methods and their contribution in the gear	:	Trawl net : 7%

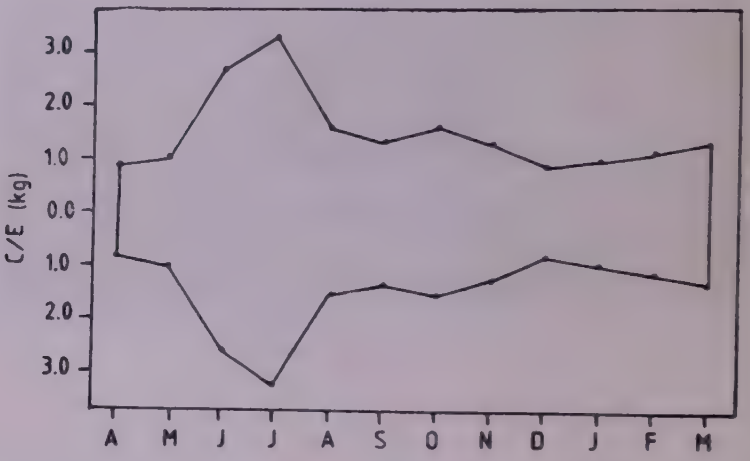


Fig. 38. Seasonal abundance of goat fishes (gear: shrimp trawls)

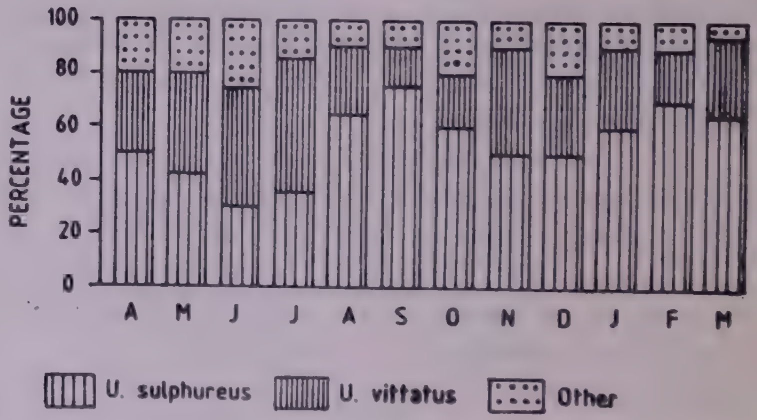


Fig. 39. Monthly species composition of goat fishes landed by shrimp trawls.

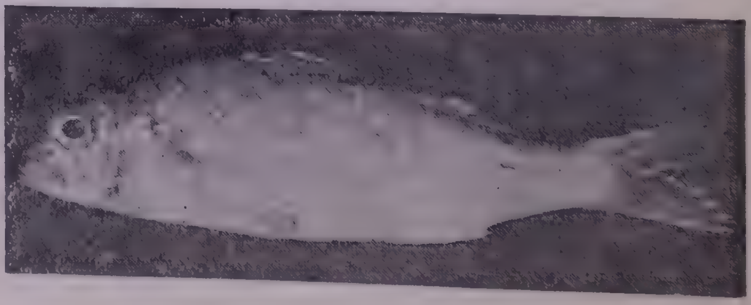


Fig. 40. *Upeneus sulphureus*.

Scientific Name : *Upeneus sulphureus*
Vernacular Name : 'Pasupu gulivindu'
Gear : Trawl net
Percentage in the catch of the group : 52
Peak period of occurrence : August – March
Depth of occurrence : 10 - 60 m
Length range in commercial fishery : 65 – 235 mm
Size at first maturity : 130 mm
Spawning season : February – March

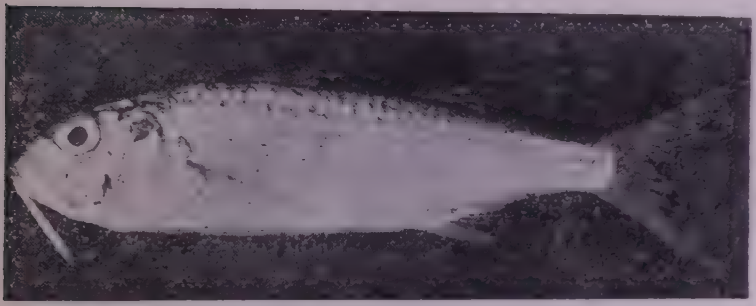


Fig. 41. *Upeneus vittatus.*

Scientific Name : *Upeneus vittatus*
Vernacular Name : 'Chara gulivindu'
Gear : Trawl net
Percentage in the catch of the group : 33
Peak period of occurrence : April – July
Depth of occurrence : 10 – 60 m
Length range in commercial fishery : 100 – 180 mm
Size at first maturity : 125 mm
Spawning season : February – March

NEMIPTERIDAE

Popular English Name : *Threadfin breams*
Vernacular Name (Telugu) : 'Gulivindalu'
Annual average catch : 830 t
Gearwise annual average catch : Trawl net : 830 t
Fishing methods and their contribution in the gear : Trawl net : 13.1%

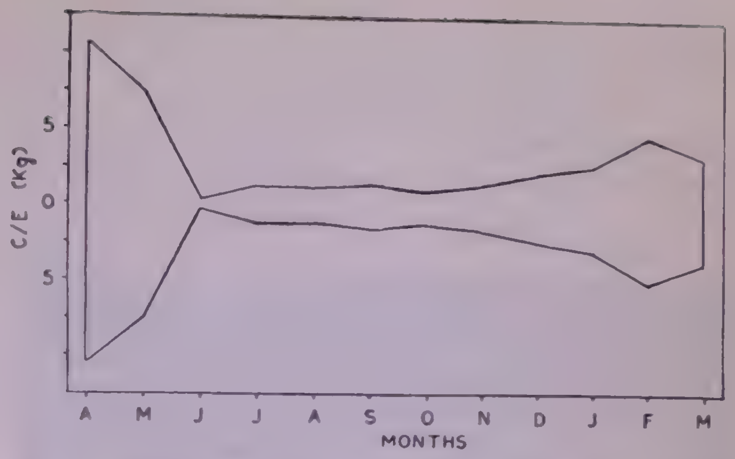


Fig. 42. Seasonal abundance of threadfin breams (gear: shrimp trawls).

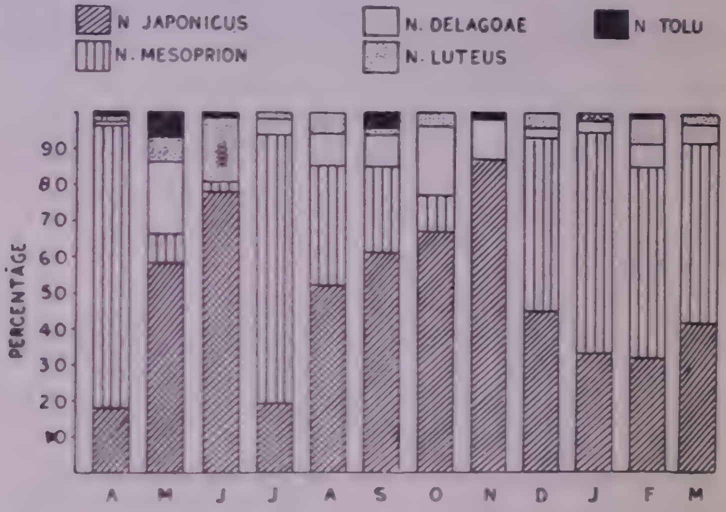


Fig 43. Monthly species composition of threadfin breams landed by shrimp trawls.

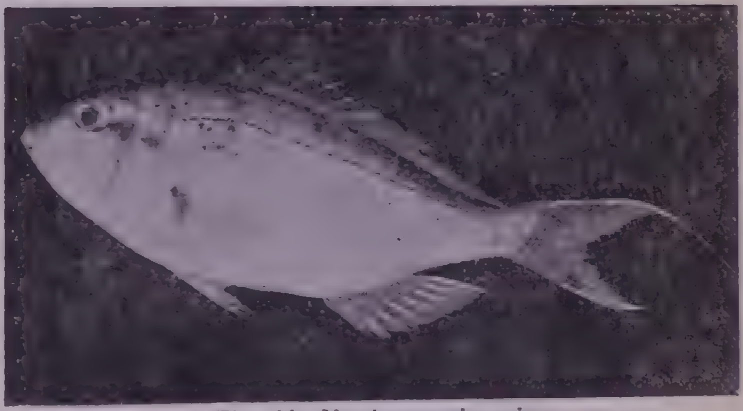


Fig. 44. *Nemipterus japonicus.*

Scientific Name : *Nemipterus japonicus*
Vernacular Name : 'Bandi gulivindalu'
Gear : Trawl net
Percentage in the catch of the group : 38
Peak period of occurrence : August – January and May – June

Depth of occurrence : 30 – 70 m
Length range in commercial fishery : 50 – 280 mm
Size at first maturity : 148 mm
Spawning season : December – February and June – July

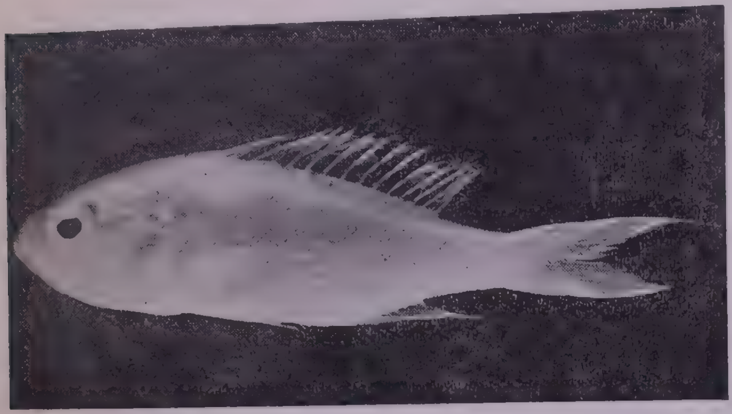


Fig. 45. *Nemipterus mesoprion.*

Scientific Name : *Nemipterus mesoprion*
Vernacular Name : 'Bandi gulivindalu'
Gear : Trawl net
Percentage in the catch of the group : 51.8
Peak period of occurrence : December – April and July – August
Depth of occurrence : 30 – 70 m
Length range in commercial fishery : 80 – 210 mm
Size at first maturity : 147 mm
Spawning season : January – April

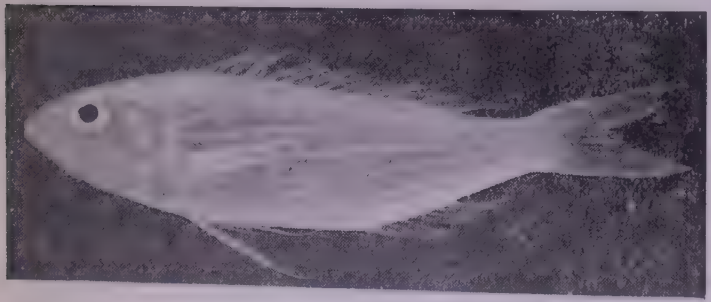


Fig. 46. *Nemipterus delagoae.*

Scientific Name : *Nemipterus delagoae*
Vernacular Name : 'Gulivindalu'
Gear : Trawl net
Percentage in the catch of the group : 6
Peak period of occurrence : May – June and October – November
Depth of occurrence : 30 – 70 m
Length range in commercial fishery : 100 – 200 mm
Size at first maturity : —
Spawning season : —

NOMEIDAE

Popular English Name : Drift fish
Vernacular Name (Telugu) : 'Methapara'
Annual average catch : 123 t
Gearwise annual average catch : Trawl net : 123 t
Fishing methods and their contribution in the gears : Trawl net : 2%

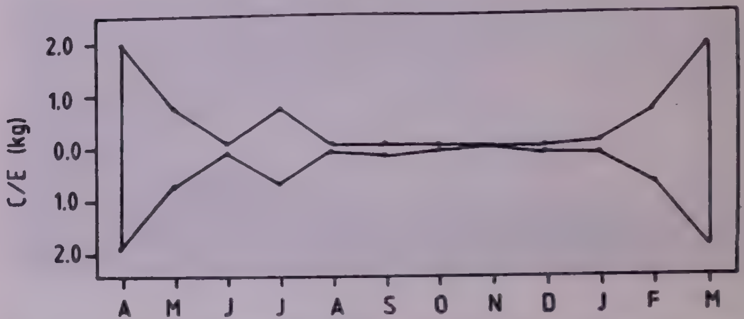


Fig. 47. Seasonal abundance of Indian drift fishes (gear: shrimp trawls).

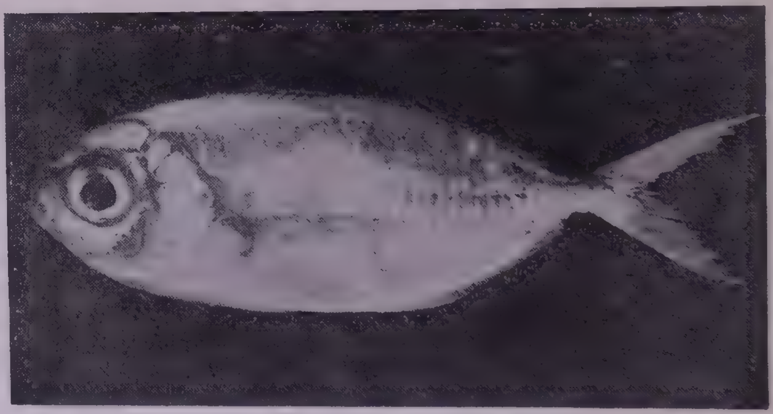


Fig. 48. *Psenes indicus.*

Scientific Name : *Psenes indicus*
Vernacular Name : 'Methapara'
Gear : Trawl net
Percentage in the catch of the group : 100
Peak period of occurrence : February – July
Depth of occurrence : 10 – 60 m
Length range in commercial fishery : 60 – 275 mm
Size at first maturity : 160 mm
Spawning season : February – June

POLYNEMIDAE

Popular English Name : Threadfins
Vernacular Name (Telugu) : 'Magalu'
Annual average catch : 53 t
Gearwise annual average catch : Trawl net : 53 t
Fishing methods and their contribution in the gears : Trawl net : 1%

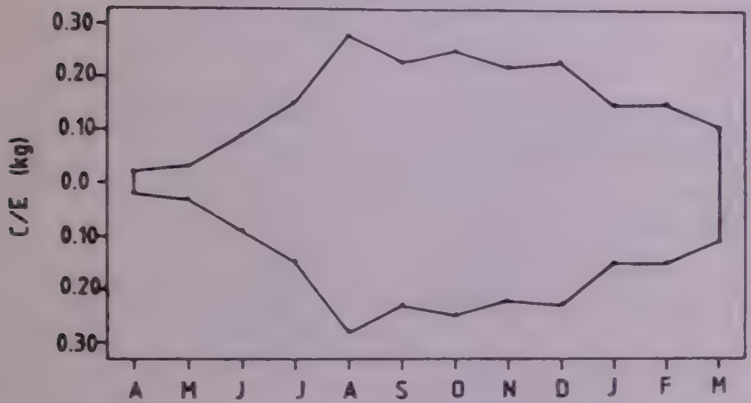


Fig. 49. Seasonal abundance of black spot threadfins (gear: shrimp trawls).

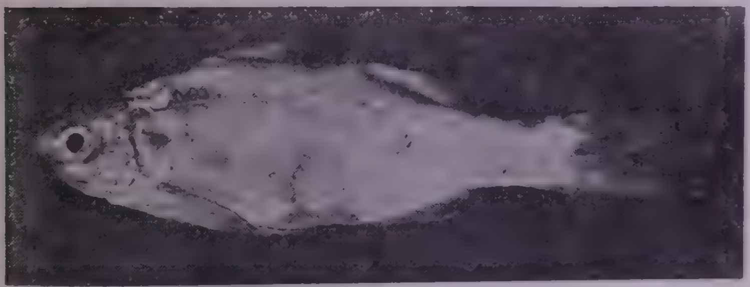


Fig. 50. *Polynemus sextarius.*

Scientific Name : *Polynemus sextarius*
Vernacular Name : 'Maga'
Gear : Trawl net
Percentage in the catch of the group : 100
Peak period of occurrence : August – December
Depth of occurrence : 10 - 60 m
Length range in commercial fishery : 100 - 210 mm
Size at first maturity : 170 mm
Spawning season : January - May

PRIACANTHIDAE

Popular English Name : Bulls eye/Big eye
Vernacular Name (Telugu) : 'Bochulu'
Annual average catch : 219 t
Gearwise annual average catch : Trawl net : 219 t
Fishing methods and their contribution in the gears : Trawl net : 3.4%

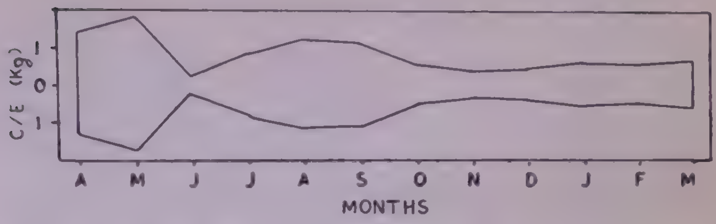


Fig. 51. Seasonal abundance of bulls eye (gear: shrimp trawl).

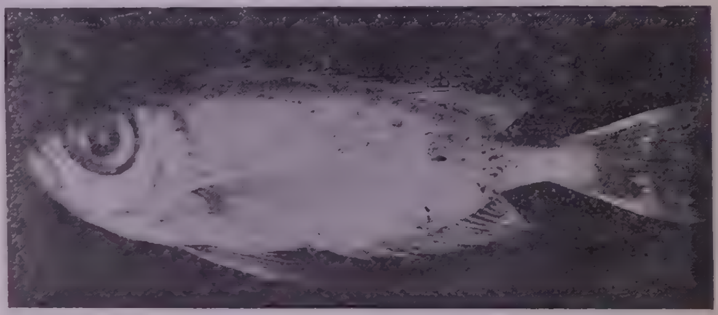


Fig. 52. *Priacanthus macrocanthus.*

Scientific Name : *Priacanthus macrocanthus*
Vernacular Name : 'Bochulu'
Gear : Trawl net
Percentage in the catch of the group : 90
Peak period of occurrence : August – March
Depth of occurrence : 30 – 70 m
Length range in commercial fishery : 100 - 230 mm
Size at first maturity : 170 mm
Spawning season : November – May

SCIAENIDAE

Popular English Name : Croakers/Jew fish
Vernacular Name (Telugu) : 'Gorasalu'
Annual average catch : 502 t
Gearwise annual average catch : Trawl net : 503 t
Fishing methods and their contribution in the gears : Trawl net : 7.9%

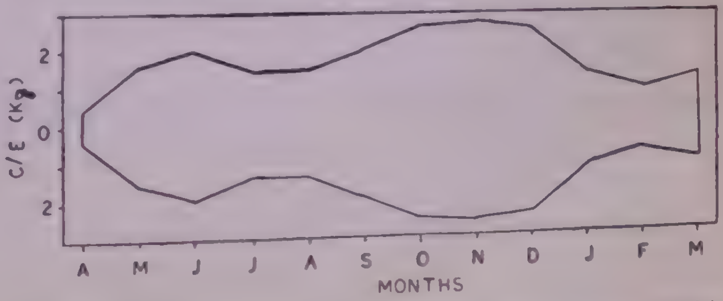


Fig. 53. Seasonal abundance of croakers (gear: shrimp trawls).

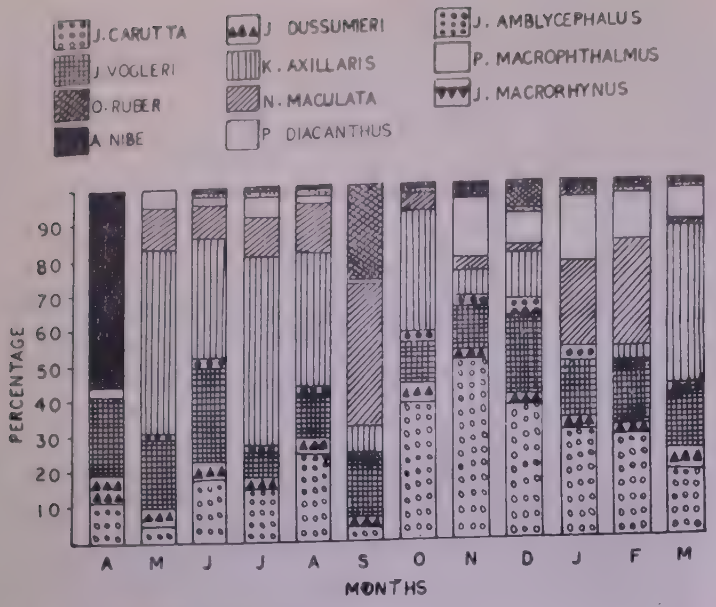


Fig. 54. Monthly species composition of croakers landed by shrimp trawls.

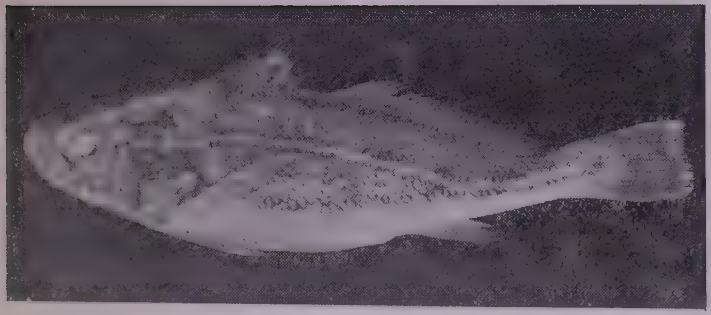


Fig. 55. *Johnius carutta.*

Scientific Name	:	*Johnius carutta*
Vernacular Name	:	'Nalla gorasa'
Gear	:	Trawl net
Percentage in the catch of the group	:	26
Peak period of occurrence	:	October – February
Depth of occurrence	:	20 - 70 m
Length range in commercial fishery	:	40 - 240 mm
Size at first maturity	:	170 mm
Spawning season	:	January - March

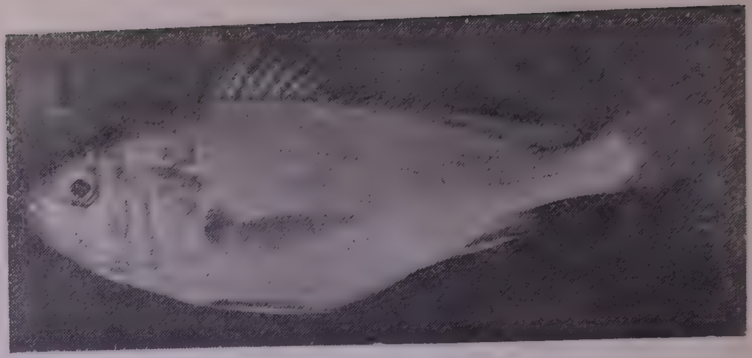


Fig. 56. *Kathala axillaris.*

Scientific Name	:	*Kathala axillaris*
Vernacular Name	:	'Gorasa'
Gear	:	Trawl net
Percentage in the catch of the group	:	25.3
Peak period of occurrence	:	July – August and October
Depth of occurrence	:	30 – 70 m
Length range in commercial fishery	:	50 – 150 mm
Size at first maturity	:	155 mm
Spawning season	:	—

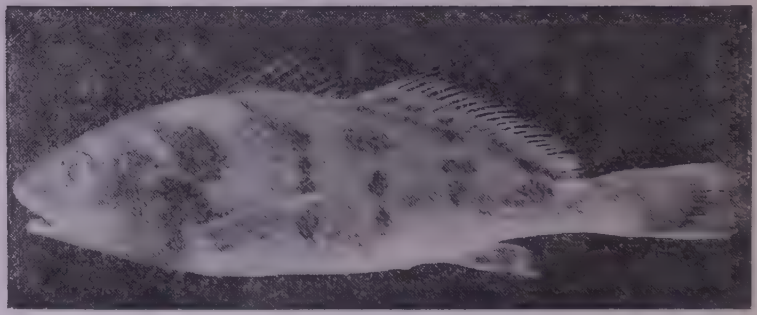


Fig. 57. *Nibea maculata.*

Scientific Name	:	*Nibea maculata*
Vernacular Name	:	'Macha gorasa'
Gear	:	Trawl net
Percentage in the catch of the group	:	12.6
Peak period of occurrence	:	May – September and January – February
Depth of occurrence	:	30 – 70 m
Length range in commercial fishery	:	70 – 240 mm
Size at first maturity	:	160 mm
Spawning season	:	—

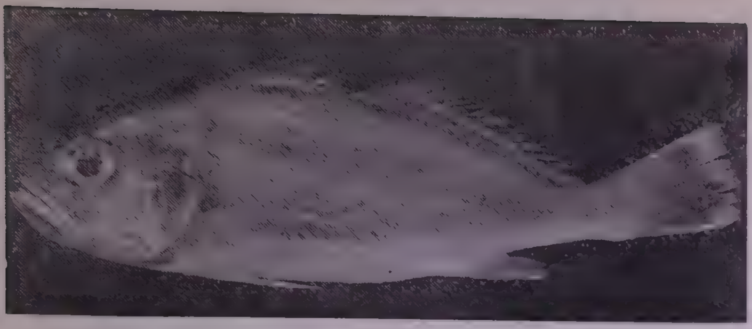


Fig. 58. *Pennahia macrophthalmus*.

Scientific Name : *Pennahia macrophthalmus*
Vernacular Name : 'Gorasalu'
Gear : Trawl net
Percentage in the catch of the group : 5.7
Peak period of occurrence : November – February
Depth of occurrence : 20 – 70 m
Length range in commercial fishery : 100 – 240 mm
Size at first maturity : 172 mm
Spawning season : December – March

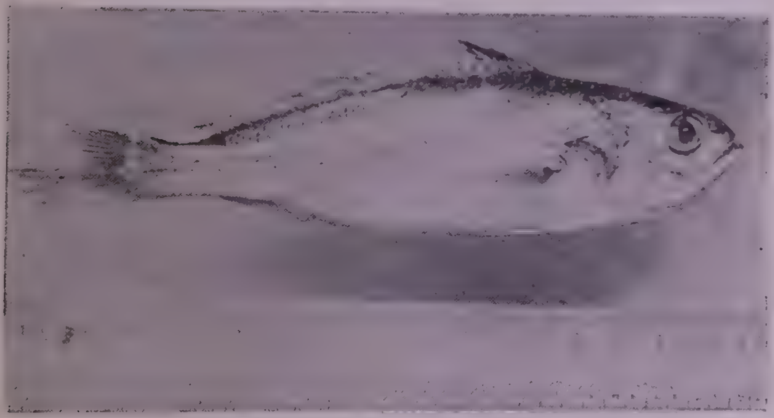


Fig. 59. *Otolithes ruber*.

Scientific Name : *Otolithes ruber*
Vernacular Name : 'Villi gorasa'
Gear : Trawl net
Percentage in the catch of the group : 5.6
Peak period of occurrence : September
Depth of occurrence : 30 – 70 m
Length range in commercial fishery : 150 – 300 mm
Size at first maturity : —
Spawning season : —

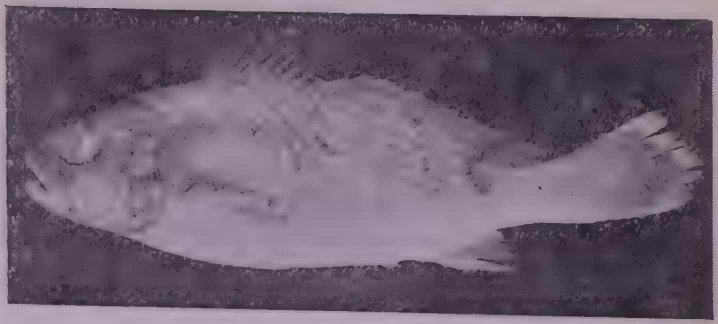


Fig. 60. *Johnieops vogleri*.

Scientific Name : *Johnieops vogleri*
Vernacular Name : 'Gorasa'
Gear : Trawl net
Percentage in the catch of the group : 16
Peak period of occurrence : March – June and Dec.
Depth of occurrence : 30 – 70 m
Length range in commercial fishery : 100 – 235 mm
Size at first maturity : 152 mm
Spawning season : February – April

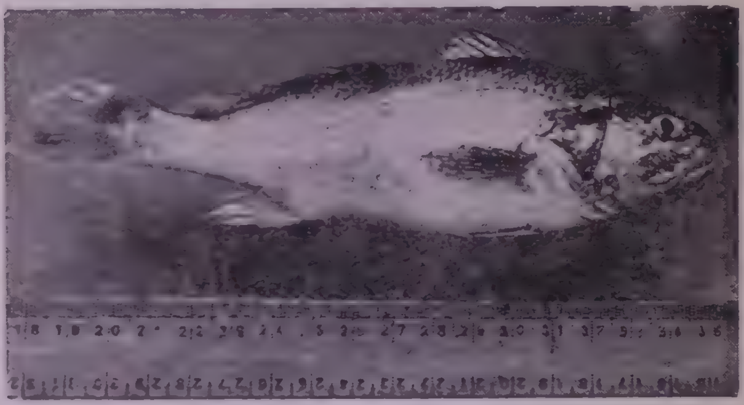


Fig. 61. *Johnieops dussumieri*.

Scientific Name : *Johnieops dussumieri*
Vernacular Name : 'Gorasa'
Gear : Trawl net
Percentage in the catch of the group : 4.3
Peak period of occurrence : February
Depth of occurrence : 30 – 70 m
Length range in commercial fishery : 100 – 180 mm
Size at first maturity : —
Spawning season : —

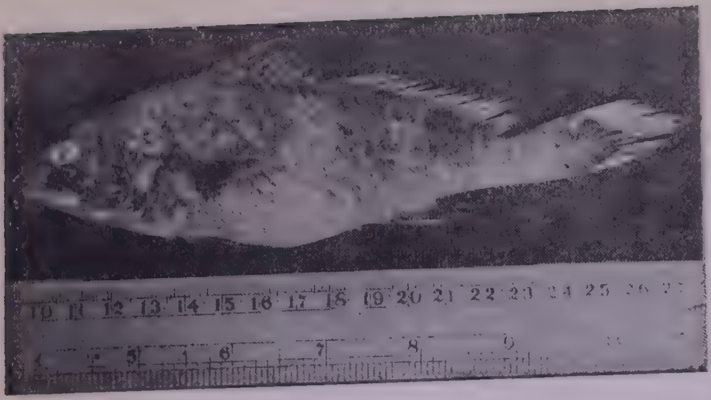


Fig. 62. *Protonibea diacanthus.*

Scientific Name : *Protonibea diacanthus*
Vernacular Name : 'Ghol'
Gear : Trawl net
Percentage in the catch of the group : 1
Peak period of occurrence : September
Depth of occurrence : 30 - 70 m
Length range in commercial fishery : 150 – 750 mm
Size at first maturity : —
Spawning season : —

SCOMBRIDAE

TUNAS

Popular English Name : Tuna
Vernacular Name (Telugu) : 'Soora'
Annual average catch : 47.7 t
Gearwise annual average catch : Hooks & line : 47.7 t
Fishing methods and their contribution in the gears : Hooks & line : 15.1 %

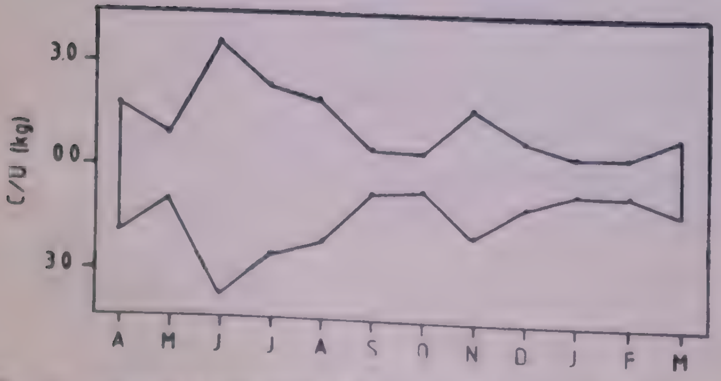


Fig. 63. Seasonal abundance of tunas (gear : indigenous gears).

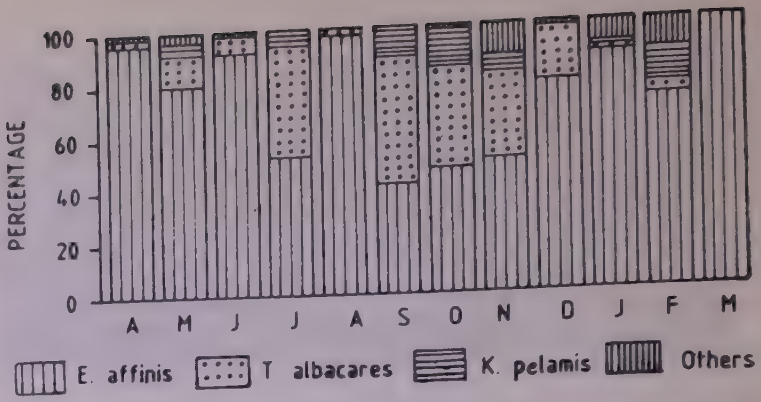


Fig. 64. Monthly species composition of tunas landed by indigenous gears.

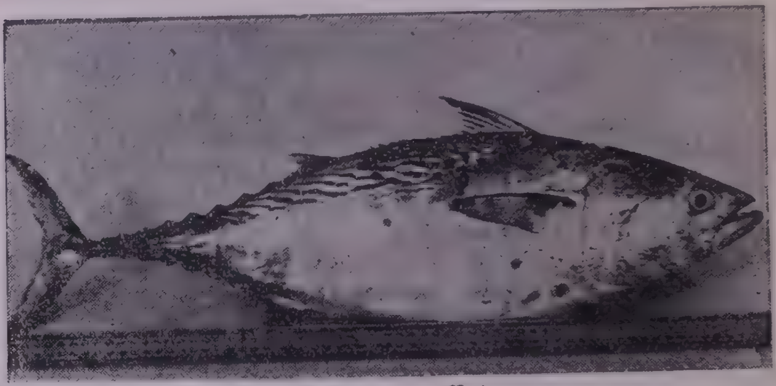


Fig. 65. *Euthynnus affinis.*

Scientific Name : *Euthynnus affinis*
Vernacular Name : 'Pala soora'
Gear : Hooks & line
Percentage in the catch of the group : 79.9
Peak period of occurrence : June – August
Depth of occurrence : 30 – 60 m
Length range in commercial fishery : 45 – 55 mm
Size at first maturity : —
Spawning season : —

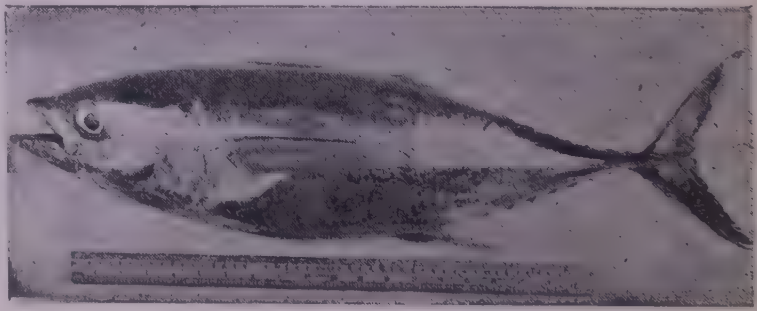


Fig. 66. *Thunnus albacares.*

Scientific Name : *Thunnus albacares*
Vernacular Name : 'Racca soora'
Gear : Hooks & line

Percentage in the catch of the group : 15.2
Peak period of occurrence : June – July and November
Depth of occurrence : 30 – 60 m
Length range in commercial fishery : 55 – 70 mm
Size at first maturity : —
Spawning season : —

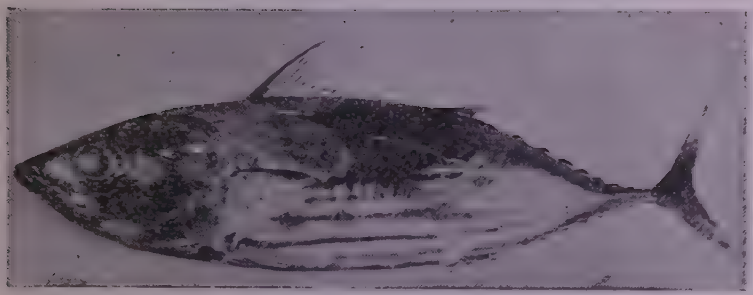


Fig. 67. *Katsuwonus pelamis.*

Scientific Name : *Katsuwonus pelamis*
Vernacular Name : 'Namala soora'
Gear : Hooks & line
Percentage in the catch of the group : 2.2
Peak period of occurrence : October – November
Depth of occurrence : 30 - 60 m
Length range in commercial fishery : 50 - 70 mm
Size at first maturity : —
Spawning season : —

SEER FISHES

Popular English Name : Seer fishes
Vernacular Name (Telugu) : 'Vanjaram'/'Konemu'
Annual average catch : 120 t
Gearwise annual average catch : Hooks & line : 105 t
Bottom set gill net : 15 t
Fishing methods and their contribution in the gears : Hooks & line : 33%
Bottom set gill net : 9%

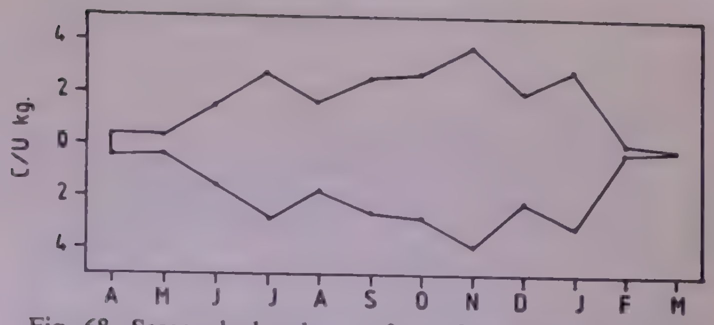


Fig. 68. Seasonal abundance of seer fishes (gear: gill nets).

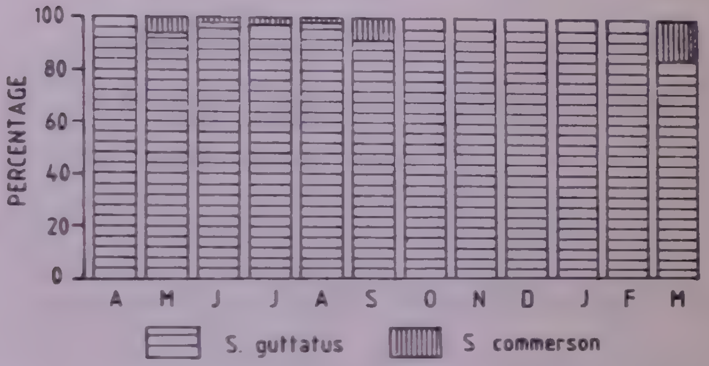


Fig. 69. Monthly abundance of seer fishes landed by gill nets.

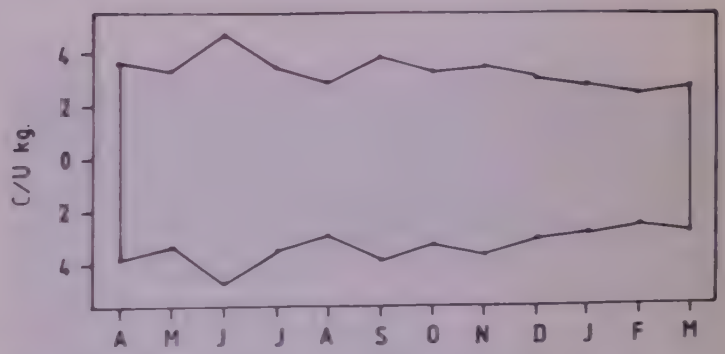


Fig. 70. Seasonal abundance of seer fishes (gear: indigenous gears).

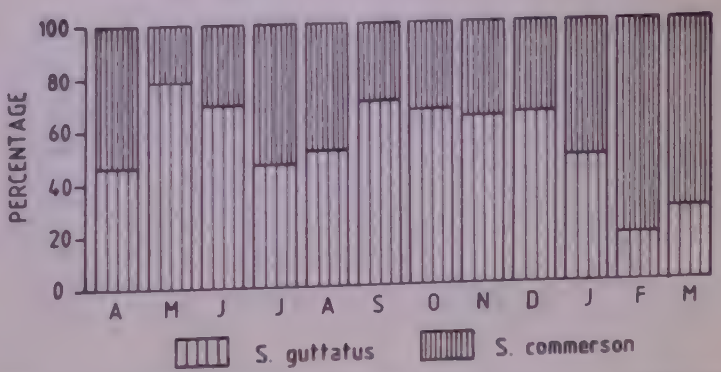


Fig. 71. Monthly abundance of seer fishes landed by indigenous gears.

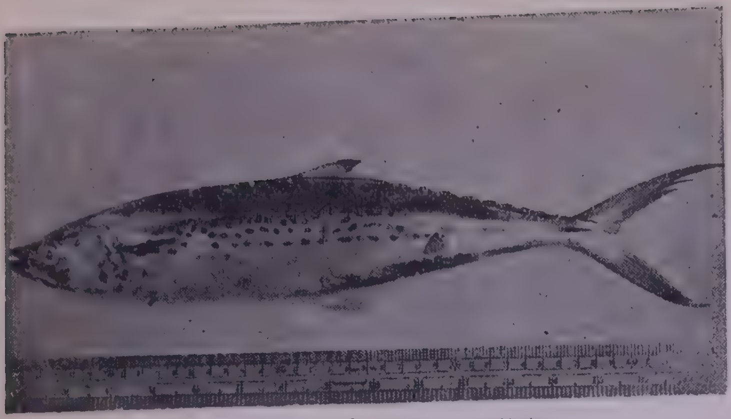


Fig. 72. *Scomberomorus guttatus.*

Scientific Name : *Scomberomorus guttatus*
Vernacular Name : 'Vanjaram'
Gear : Hooks & line/ Bottom set gill net
Percentage in the catch of the group : Hooks & line : 55
Bottom set gill net : 98
Peak period of occurrence : May - July / September-October and January
Depth of occurrence : 20 – 100 m
Length range in commercial fishery : 300 – 800 mm
Size at first maturity : 300 mm
Spawning season : February – March and July

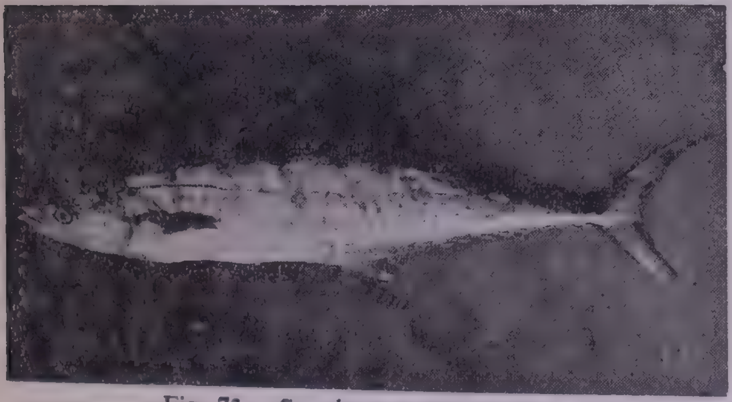


Fig. 73. *Scomberomorus commerson.*

Scientific Name : *Scomberomorus commerson*
Vernacular Name : 'Konemu'
Gear : Hooks & line/Bottom set gill net
Percentage in the catch of the group : Hooks & line : 45
Bottom set gill net : 2
Peak period of occurrence : February – April and July
Depth of occurrence : 50 - 100 m
Length range in commercial fishery : 400 – 1000 mm
Size at first maturity : —
Spawning season : —

MACKEREL

Popular English Name : Indian Mackerel
Vernacular Name (Telugu) : 'Kanagurta'
Annual average catch : 134 t
Gearwise annual average catch : Drift gill net : 94 t
Trawl net : 32 t
Shore seine & boat seine : 8 t

Fishing methods and their contribution in the gear : Drift gill net : 67%
Shore seine & boat seine : 3%
Trawl net : 0.5%

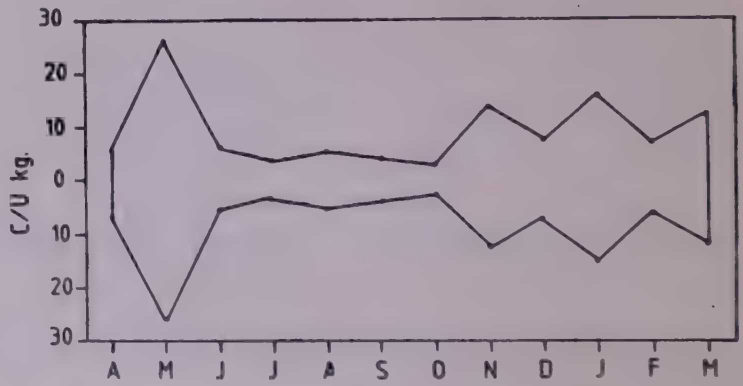


Fig. 74. Seasonal abundance of mackerel in gill nets.

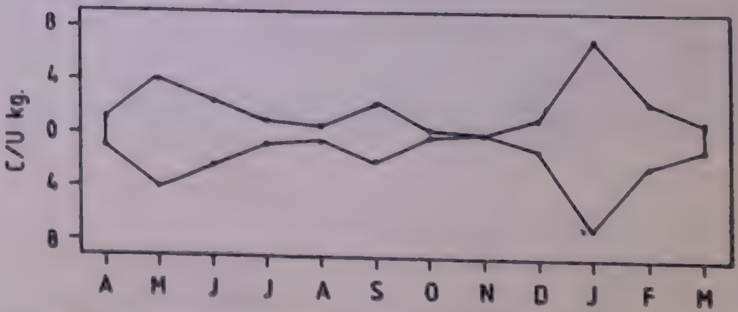


Fig. 75. Seasonal abundance of mackerel in indigenous gears.

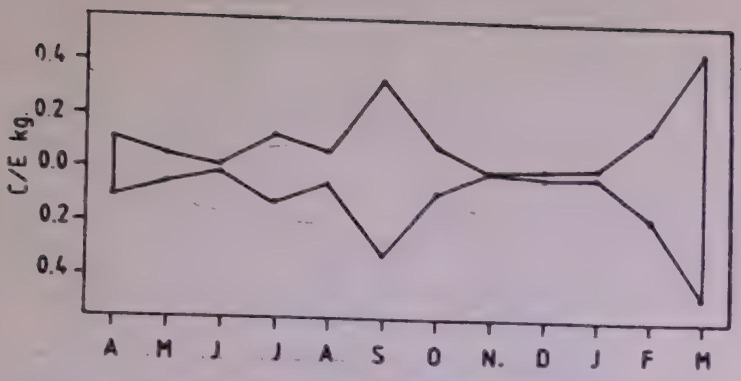


Fig. 76. Seasonal abundance of mackerel in trawl nets.

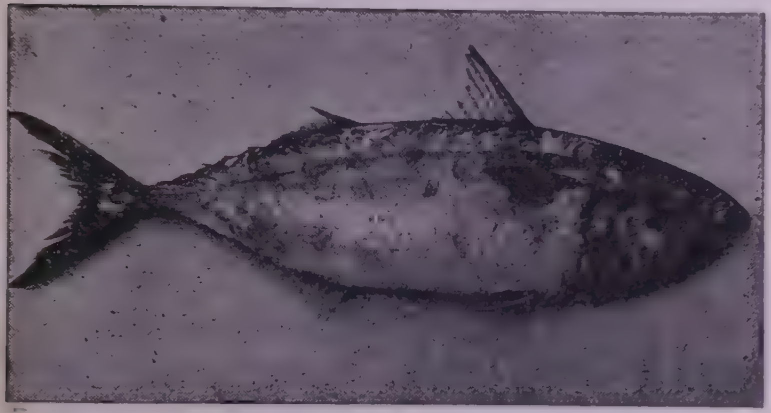


Fig. 77. *Rastrelliger kanagurta.*

Scientific Name	:	*Rastrelliger kanagurta*
Vernacular Name	:	'Kanagurta'
Gear	:	Drift gill net/Trawl net/ Boat seine/Shore seine
Percentage composition in the gear	:	Drift gill net : 98 Shore seine & boat seine : 100 Trawl net : 100
Peak period of occurrence	:	January – May
Depth of occurrence	:	1 – 60 m
Length range in commercial fishery	:	40 – 270 mm
Size at first maturity	:	185 mm
Spawning season	:	October – April

SYNODONTIDAE

Popular English Name	:	Lizard fishes
Vernacular Name (Telugu)	:	'Bademattalu'
Annual average catch	:	625 t
Gearwise annual average catch	:	Trawl net : 625 t
Fishing methods and their contribution in the gears	:	Trawl net : 9.8%

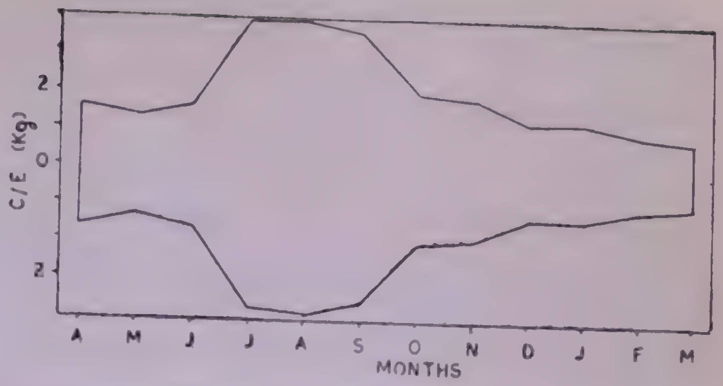


Fig. 78. Seasonal abundance of lizard fishes (gear: shrimp trawl)

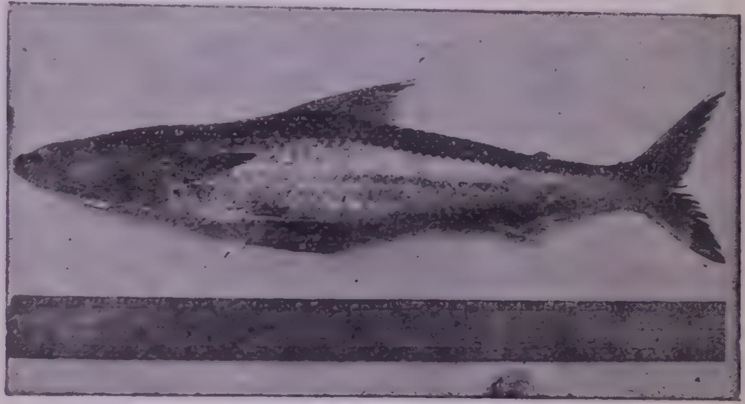


Fig. 79. *Saurida tumbil.*

Scientific Name	:	*Saurida tumbil*
Vernacular Name	:	'Badematталu'
Gear	:	Trawl net
Percentage in the catch of the group	:	Trawl net : 60
Peak period of occurrence	:	July – September
Depth of occurrence	:	30 – 70 m
Length range in commercial fishery	:	40 – 320 mm
Size at first maturity	:	—
Spawning season	:	October - March

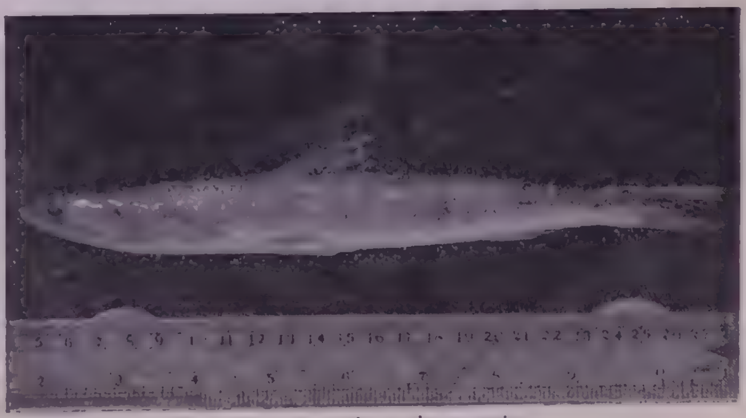


Fig. 80. *Saurida undosquamis.*

Scientific Name : *Saurida undosquamis*
Vernacular Name : 'Badematalu'
Gear : Trawl net
Percentage in the catch of the group : Trawl net : 35
Peak period of occurrence : July – September
Depth of occurrence : 30 – 70 m
Length range in commercial fishery : 50 – 210 mm
Size at first maturity : —
Spawning season : —

TACHYSURIDAE

Popular English Name : Cat fish
Vernacular Name (Telugu) : 'Jellalu'
Annual average catch : 179.1 t
Gearwise annual average catch : Trawl net : 124.4 t
Hooks & line : 54.7 t

Fishing methods and their contribution in the gears : Hooks & line : 15.5%
Trawl net : 1.7%

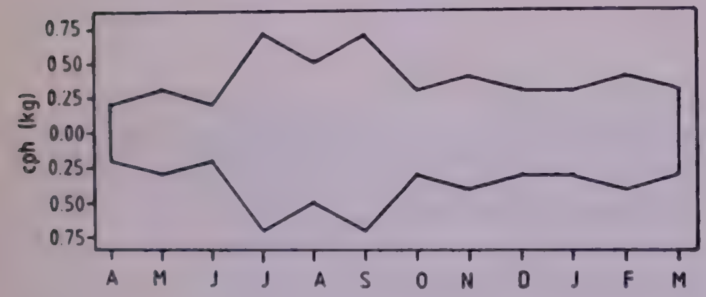


Fig. 81. Seasonal abundance of cat fish (gear: shrimp trawl)

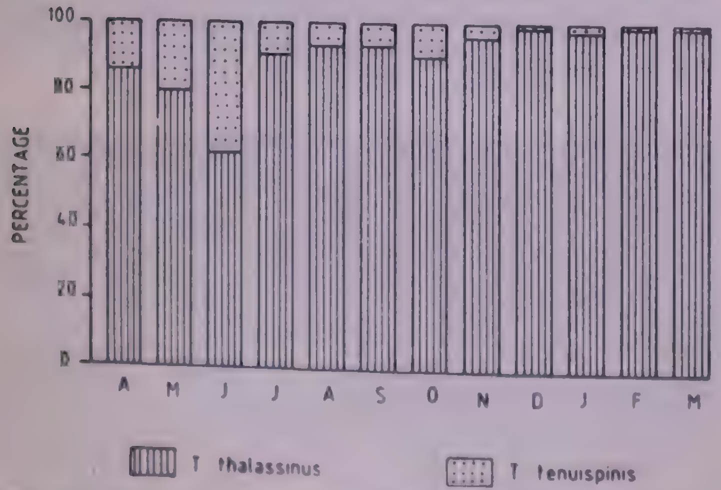


Fig. 82. Monthly species composition of cat fish landed by shrimp trawls.

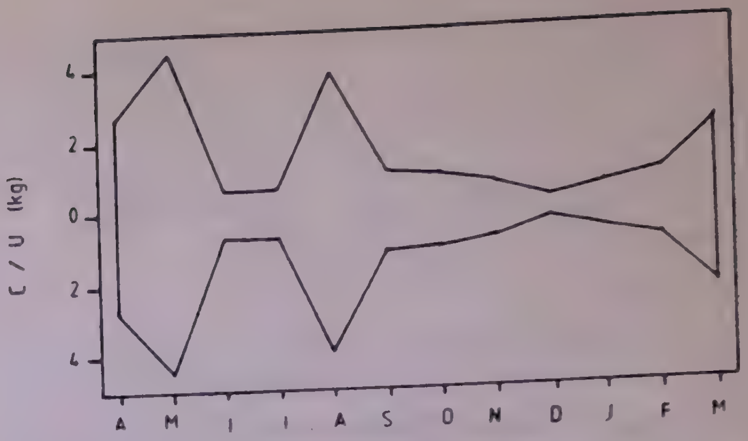


Fig. 83. Seasonal abundance of cat fish (gear: other indigenous gears).

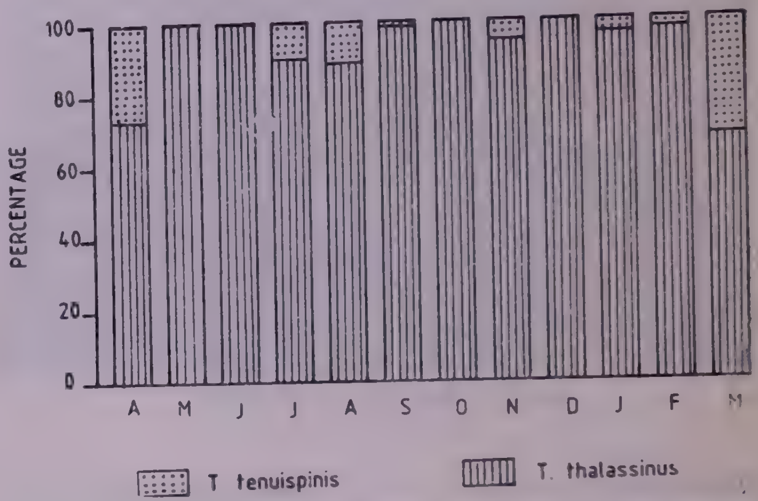


Fig. 84. Monthly species composition of cat fish landed by other indigenous gears.

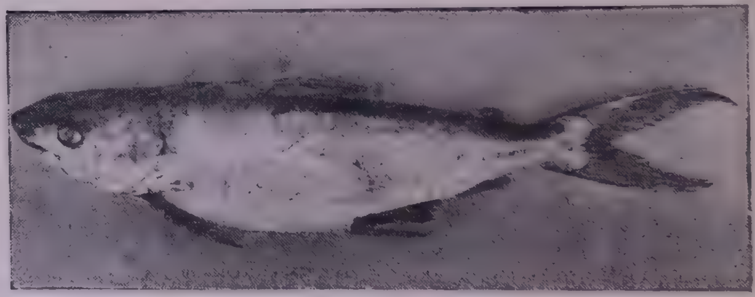


Fig. 85. *Tachysurus thalassinus.*

Scientific Name : *Tachysurus thalassinus*
Vernacular Name : 'Thella jalla'
Gear : Trawl net/Hooks & line
Percentage in the catch of the group : Trawl net : 1.7
Hooks & line : 15.6
Peak period of occurrence : March – December
Depth of occurrence : 10 – 80 m
Length range in commercial fishery : 80 – 660 mm
Size at first maturity : 360 mm
Spawning season : May - July

TRICHIURIDAE

Popular English Name : Ribbon fishes
Vernacular Name (Telugu) : 'Savallu'
Annual average catch : 574.4 t
Gearwise annual average catch : Trawl net : 574.4 t
Fishing methods and their contribution in the gears : Trawl net : 8%

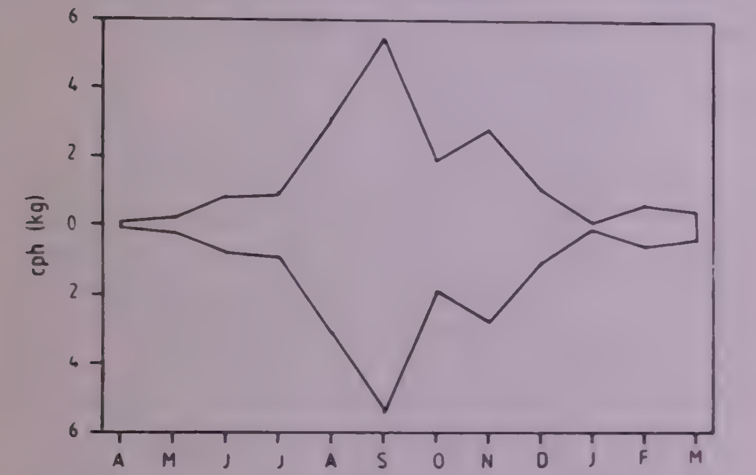


Fig. 86. Seasonal abundance of ribbon fishes (gear: shrimp trawls).

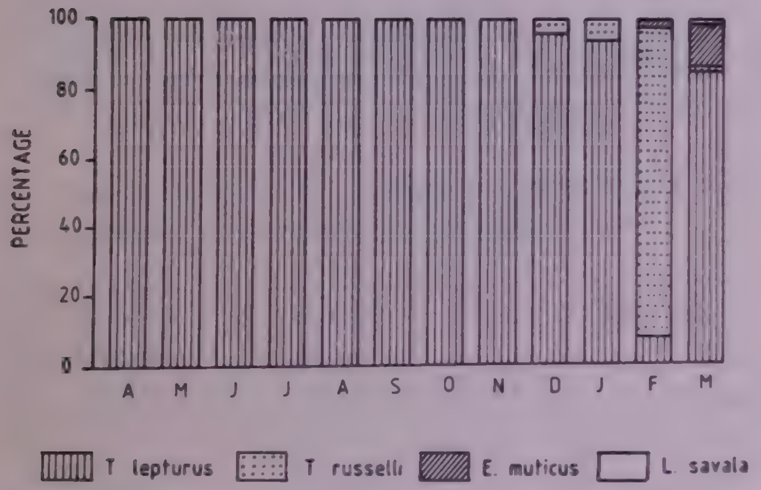


Fig. 87. Monthly species composition of ribbon fishes landed by shrimp trawls.

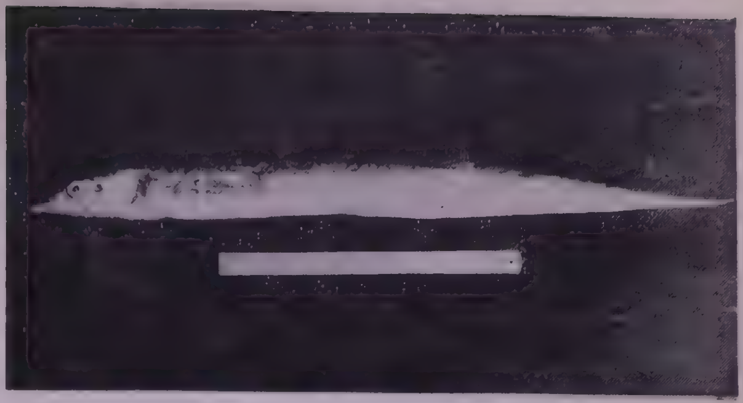


Fig. 88. *Trichiurus lepturus.*

Scientific Name : *Trichiurus lepturus*
Vernacular Name : 'Savallu'
Gear : Trawl net
Percentage in the catch of the group : 96.4
Peak period of occurrence : July – November
Depth of occurrence : 10 – 80 m
Length range in commercial fishery : 150 – 1000 mm
Size at first maturity : 525 mm
Spawning season : February – June

SOME OBSERVATIONS ON THE FOOD CONSUMPTION PATTERN AND NUTRITIONAL STATUS OF A MARINE FISHERMEN COMMUNITY

Krishna Srinath

Central Marine Fisheries Research Institute, Cochin

Introduction

Nutritional status is an indicator of socio-economic well being of a community. Extensive diet surveys carried out in the country have shown that a good proportion of the population which belongs to low income group is not able to fulfil the requirements of nutrients including the major ones like calories and protein. To understand the food consumption pattern and nutrient intake of artisanal fishermen community, an investigation was carried out in Vypeenkara, Cochin during 1982–'83 and the findings are reported here.

Methodology

A survey was conducted selecting 150 households to find out the weekly food consumption pattern. The total quantity of food bought every week and the frequency of consumption by the surveyed households were recorded through personal interviews with housewives, with the help of an interview schedule. To study the nutritional status of pre-school children, weight of 100 children were collected from the school health records and compared with the UNICEF standard used in Integrated Child Development Scheme (ICDS). Personal discussions were held with the school teachers, extension officer for women and child welfare at the local C.D. Block and the medical officer in charge of the primary health centre of the area to find out the general pattern of nutrition and nutritional disorders.

Occupation, income, educational status and family size

Among the households selected for the study, 57% was engaged in marine fishing as labourers, 38.5 % using own fishing equipment and the rest engaged in other fishery related activities like trading and post harvest operations. The household income ranged from Rs. 5–10 in the case of fishing labourers, Rs. 10–25 in the case of fishermen owning craft/gear and Rs. 25–30 in the case of traders (Table 1). The educational status of the heads of household is given in Table 2. The percentage of men, women and children in the sample was 37.5, 36.0 and 26.5 respectively with the average family size of 5.6.

Food consumption pattern

Table 3 gives the food consumption pattern in the selected households. It is seen that the diets consist mainly of rice and fish which meet only 75% of the calories and 50% of the protein needs. The quantity and frequency of consumption of other protein foods such as egg, meat and milk are considerably less. The foods like vegetables which form the major source of vitamin and iron are rarely included in the diet. Hence these have not been taken into account for computing nutrient in-take. Table 4 gives the average nutrient intake of the fishermen households. The average intake of 'CU' (consumption unit) for calories has been worked out at the rate of 2,400 for adult, though it is felt that an active sea-going fisherman requires the allowance of 3,900 calories, the type of activity being heavy work with considerable environmental stress.

Table 1. *Estimated percentage of occupation and income range of the marine fishermen community*

Occupation	% Families engaged	Income (Rs./day)
Fishing labour	57.0	5–10
Fishing using own craft/gear	38.5	10–25
Fish trading	4.5	20–30

Table 2. *Educational status of heads of households of marine fishermen community*

Education	% Individuals
< Primary	46
Primary	39
Secondary	14
> Secondary	1

Table 3. *Average per capita intake of food stuff by marine fishermen community*

Food	Quantity	Frequency of consumption (days/week)	Recommended daily allowance	Average in take for rural Kerala*
Cereals	260	7	475	369
Pulses	10	2–3	6–5	23
Vegetables	50	2–3	75	56
Leafy vegetables	100	1	125	7
Fruits	50	1	30	25
Roots and tubers	200	1	100	80
Fish	100	7	30	54
Other flesh food	30	1	30	12
Milk & buttermilk	50	1	200	79
Sugar	15	7	40	22
Fats & oils	10	7	40	6

* ICMR, 1982

Table 4. *Nutrient intake of fishermen community*

Nutrient	Average intake	Average intake for low income groups in Kerala*	Recommended daily allowance**
Calories	1,827	1,688	2,400–2,800
Protein (g)	27.35	34.58	55
Calcium (mg)	417.3	413.6	400–500
Iron (mg)	11.75	16.68	24.00
Riboflavin (mg)	0.54	0.642	1.4
Thiamine (mg)	0.28	0.588	1.2
Niacin (mg)	318	8.96	755
Vitamin C (mg)	—	75.2	4.0

*Rajammal, 1978.
**ICMR 1981, *Recommended dietary intake for Indians.*

Food habits and meal pattern

A balanced meal is rare in most of the households excepting during peak season in fishery. Breakfast is seldom prepared and food prepared in the previous night, if left over, is used in the morning. Difficulty in providing breakfast was identified as a reason for children dropping out from schools.

In households which own fishing crafts and where men leave for fishing in the early hours, breakfast is prepared, usually consisting of *ada* and *unda* made of rice flour/wheat flour, plantain and jaggery and black tea. In such households it is customary to serve breakfast for other crew men who accompany the craft owners. Of late sea shore tea shops coming up in increasing numbers have taken up the job and fishermen consume breakfast from these shops before or after fishing trips. *Puttu* made of rice flour and coconut, Bengal gram curry, *pakora* made of bread and Bengal gram flour, *aval* (rice flakes) and banana fry are the items of breakfast generally served in these shops. A Rs. 2 worth breakfast could provide 150 g *puttu* and 100 g Bengal gram curry and 1 cup tea with milk and sugar. The advantage for fishermen with these tea shops is that they can eat food on credit and pay when they get money. Fishermen prefer to carry rice-cooked plain or in the form of *kanji* (gruel) and *chammandi* (chutny) on their fishing trips as they think that such diet prevents them from getting thirsty and reduces the demand on water which is to be carried with them. During longer fishing trips food is often cooked onboard.

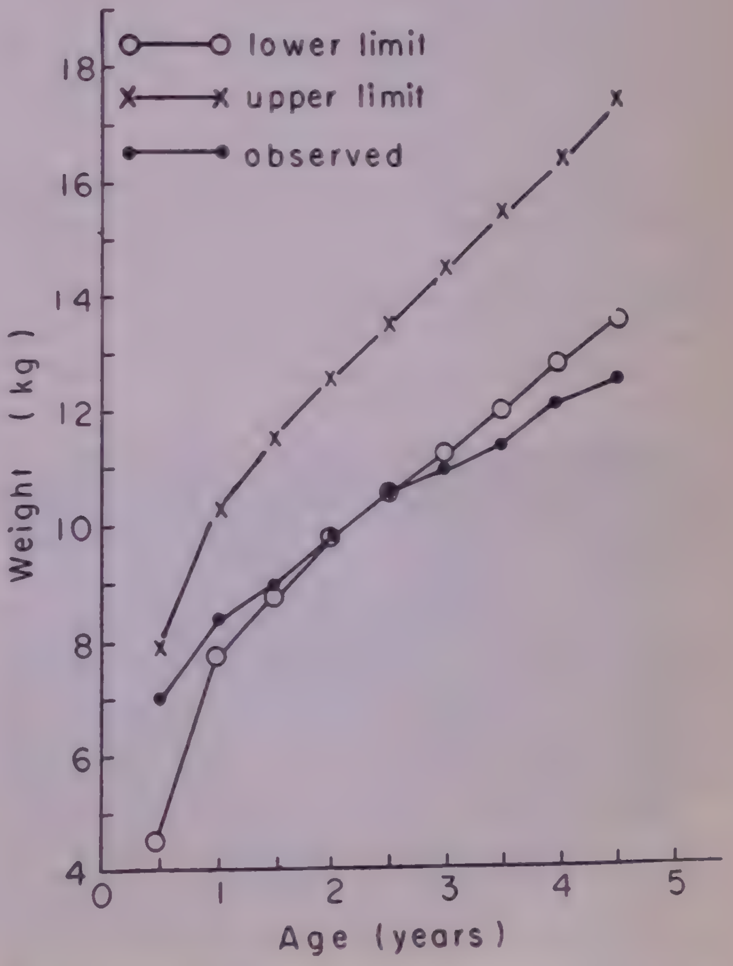


Fig. 1. Graph showing weight of school children plotted against the standard UNICEF curve.

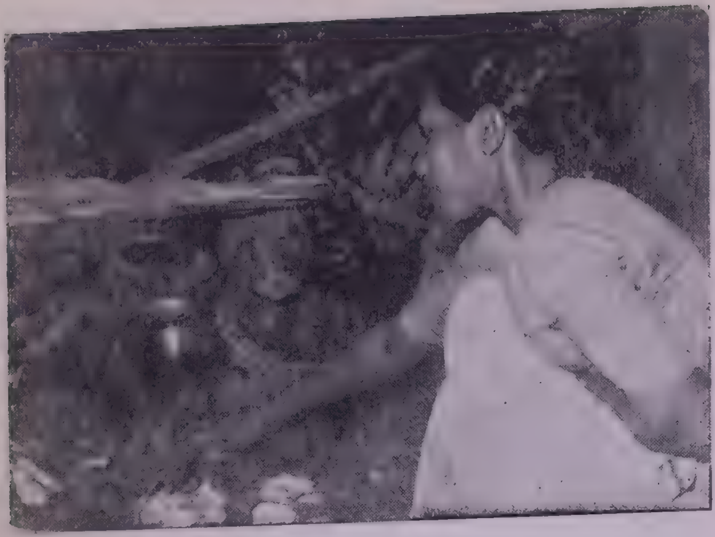


Fig. 2. Food being prepared in a fisherman's hut.

The lunch mainly consists of rice, fish curry and fish fry made of oil sardine and other fish. Vegetables and buttermilk find a place in the diet rarely. Milk is not included in the diet excepting in the case of pre-school children. Meat is cooked once a month or during festivals. Men make it a point to bring a portion of the daily catch of fish for the family. The first cereal to be introduced in the diets of infants is usually ragi. By the time the child completes first year it is introduced to all foods consumed by the family.

Food is scarce during lean fishing season. Women bear the consequence of food scarcity which occurs four or five times a year. Even during such hard times neighbours extend mutual help and exchange small quantities of rice so that some *kanji* can be prepared. The welfare programmes of government include free ration for fishermen during adversities but no information was collected on the utilization of the same. The assets including ration cards are pledged during lean season to buy food and medicine. Another difficulty faced by them is buying of weekly ration by paying ready cash. Hence there is a tendency to buy food at higher price from open market on credit. Firewood and coconut husk and shell are used for cooking which have to be bought on price.

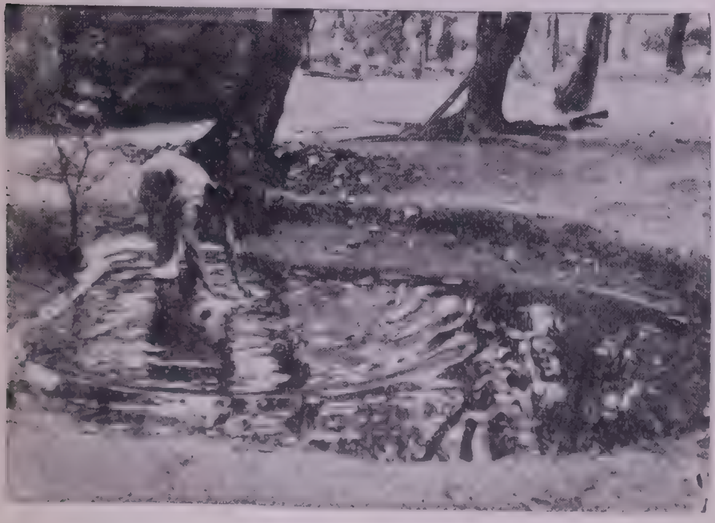


Fig. 3. A woman collecting rain water from a stagnant pool during rainy season.

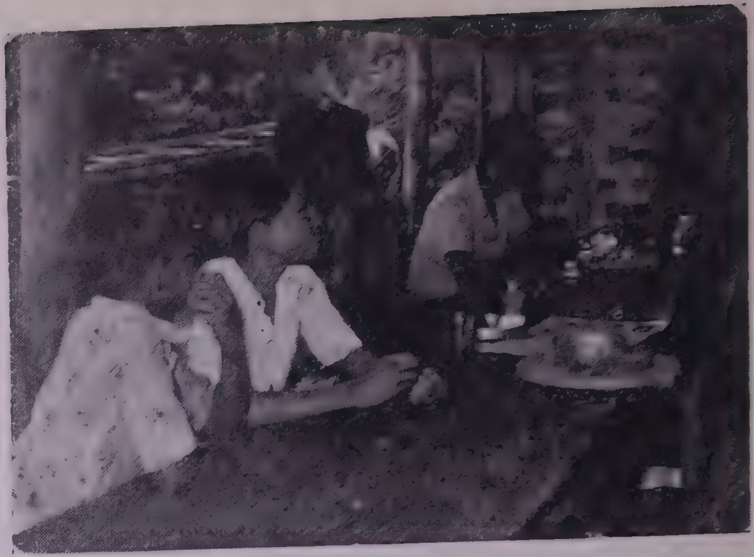


Fig. 4. Fishermen taking food from sea shore tea shop.

The houses, generally small huts have some space set apart for preparation of food and is kept clean. Earthern and aluminium wares are used for cooking. A few stainless steel and glass wares are kept aside for the use of guests. The women are in the habit of listening women's programmes over the radio and try to understand the importance of nutrition but it is difficult for them to practice the knowledge because of low income. The local C. D. Block has been encouraging kitchen gardening through free supply of vegetable seed. There are also programmes for goat keeping and poultry. But it is difficult to grow vegetables in the coastal areas especially during summer due to high soil salinity and scarcity of fresh water. Coconut and seasonal paddy called 'pokkali' are the major crops in the island. Among vegetables cowpea is the most commonly cultivated one along the bunds of prawn fields. Corporation taps on the main road are the major source of drinking water and women have to spend a good portion of their time in fetching potable water. Water in small pools stagnated in the homesteads is used for washing during monsoon.

Fig. 5. 'Savala vada' and bread 'pakora' in a sea shore tea shop.

Nutritional status of pre-school children

The weight of 100 school children collected from two *balawadis* plotted against the standard UNICEF curve for Indian children is presented (Fig. 1). Nearly upto the age of three years the weights are found to be within the standards and then show a decline. Allergic bronchitis, asthma due to coastal climate, worm infestation, anaemia and dental caries are the health disorders commonly found among children. The coastal villages fall victim to gastro-enterites during monsoon due to lack of adequate sanitation.

Remarks

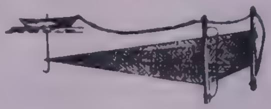
One of the major problems encountered in the development of fishermen community has been their low nutrient intake. Rajammal and Nirmala (*Proc. Seminar on Small-scale Fish. and Coastal Aquacul. in Inte. Rural Development*, CMFRI, 63–68, 1978) observed that there was conspicous gap in the vital data about the nutritional status of the fishing community. However, the information available on district averages show that the nutritional intake of low income groups in coastal Kerala and the anthrapometric measurements of fishermen children are found to be below the required standards. The present study on food consumption pattern and nutritional status of artisanal fishermen community in Vypeen also confirms the above findings.

The average nutrient intake for coastal Kerala (Rajammal and Nirmala, 1978 *(op. cit.)* and the rural Kerala (National Nutrition Monitoring Bureau, ICMR, Hyderabad, 1984) has indicated adequate intake of calcium and vitamin C coming from food stuffs like millets and vegetables. But in the present study the intake of vitamin C is found to be low since vegetables and fruits are almost absent in the diets of fishermen in this area. The high incidence of malnutrition of this particular community can mainly be attributed to two factors namely low purchasing power and non-availability of protective foods like leafy and other vegetables in the coastal areas. Lack of alternative sources of protein mainly results from low purchasing power. The major reason contributing to low purchasing power is uneven distribution of income over the year due to high seasonality of occupation. The fishermen are caught in a vicious circle of borrowing and paying back money which results in low savings and heavy debts. The most important step in the upliftment of the community is to increase the purchasing power by increasing the income from fisheries and introducing supplementary occupations, so that at least the requirements for protein and calories are met.

Another step in mitigating malnutrition will be increasing the production of animal protein and pro-

Fig. 5. Mobile tea shops managed by women are popular in the sea shore. Tea and snacks are served here.

tective foods in the coastal villages which will help in adding variety to the daily diets. Efforts may be intensified to find out suitable varieties of vegetables, especially leafy and also encourage poultry, piggery, duckery and dairy farming. Integrating these systems of farming with prawn and fish culture and utilization of the products and by-products will help the population to produce and consume more. An open question put to the women of the area showed that they in general had favourable attitude towards small family norm and some measure or other is being followed by them to limit the family size. Efforts may also be intensified to educate the fishermen on these lines so that doubts and superstitions prevalent among them are cleared.



UNUSUAL FISHERY FOR OIL SARDINES ALONG THE WEST SAURASHTRA COAST*

Introduction

The Indian oil sardine *Sardinella longiceps* Valenciennes is the most important pelagic fishery wealth of the southwest coast of India and occasionally contributes as much as quarter of our marine fish landings. Normally the landings fluctuate between 10–18% of the total marine fish catches. In the past several decades, the oil sardine fishery has shown remarkable fluctuations both spatially and seasonally. Since 1981-'82 oil sardine fishery has been showing a declining trend.

Year		Oil sardine landings
1981–'82	...	2,55,644 tonnes
1982-'83	...	2,01,625 ,,
1983–'84	...	1,80,081 ,,
1984–'85	...	1,65,537 ,,

Oil sardines though formed one of the major pelagic resources on the west coast, have never formed a fishery along the Saurashtra coast. They have been only once reported from east coast at Pondicherry during October to December, 1983. (Srinivasarengan and Chidambaram, *Mar. Fish. Infor. Serv. T & E Ser.*, **61**, 1985). Part of west Saurashtra coast (from Lat. 21°08′ N, Long. 70°14′E to Lat. 22°14′N, Long. 60°01′E) observed heavy landings of oil sardines for the first time during winter months of 1986–87, and the present report gives brief account of its fishery and biology.

Fishery

An estimated 352 tonnes of oil sardine were landed during mid November to February end. Peak landings were observed during 16th December to 31st January. Total period for oil sardine fishery can be conveniently divided into three distinct phases.

Phase 1. — 15th Nov. '86 to 15 Dec. '86
Phase 2. — 16th Dec. '86 to 31st Jan. '87
Phase 3. — 1st February '87 to 28th Feb. 87.

Only stray catches of oil sardine were landed during the first phase and therefore didn't contribute much to its fishery. Second phase marked the period of bumper catches particularly at Miani, Porbandar and Navibandar landing centres and also at Madhavpur to a certain extent. At Navibandar and Miani it formed more than 90% of fish landing during this phase. An estimated total of 332 tonnes of oil sardine were landed with a CPUE of 277.21 kg/boat. Third phase marked the declining of fishery and only 20 tonnes of oil sardines were reported with CPUE of 80–100 kg/boat from all the three major landing centres.

The oil sardine shoals were caught by cast nets at depths of 6 to 8 m and within 800 m range from the shore. During January, dense shoals, close to the shore were seen frequently by fishermen at Navibandar. These shoals were so dense that they changed the colour of water near the bank. The shoals were caught from

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*Prepared by R. K. Fotedar and Y. D. Savaria, Veraval Research Centre of CMFRI, Veraval.

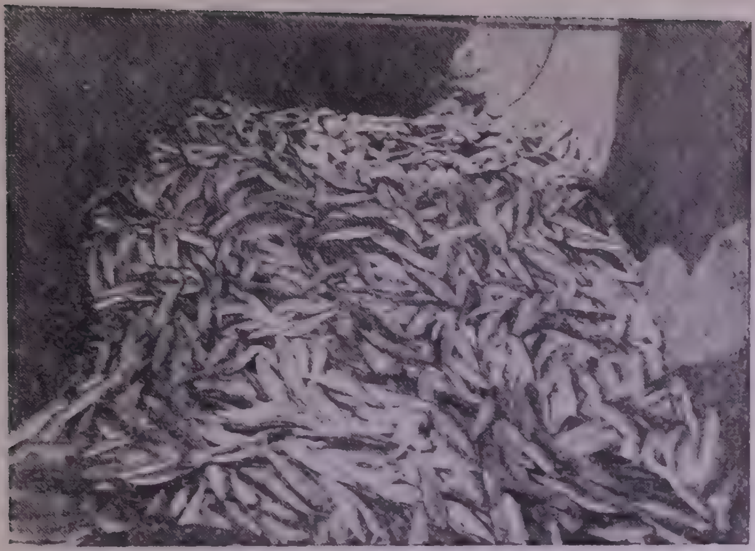

Fig. 1. Harvested *Sardinella longiceps* at Navibandar.

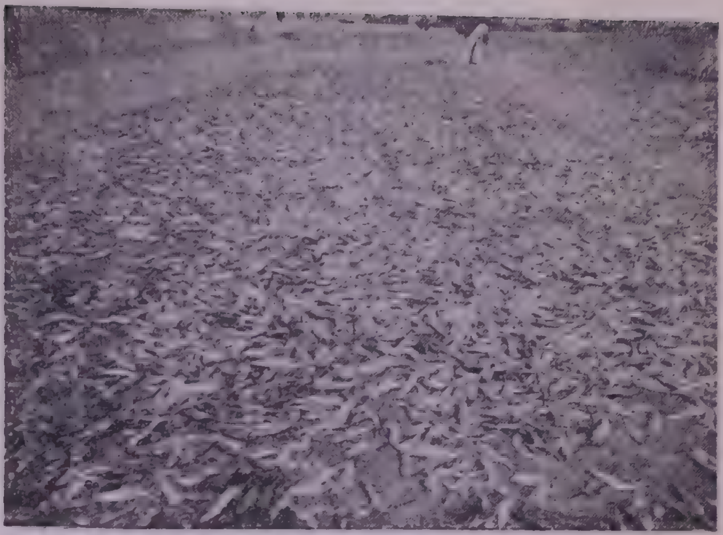

Fig. 2. Salt curing in progress at Porbandar.

dugout canoes and fibre glass boats using cast nets of mesh size 21–27 mm.

Price of oil sardine fluctuated from 40 paise to Re. 1 per kg. They were dried in the sun after salting. After drying the price was fixed at Rs. 80–90 per 20 kg.

Biological observations

A total of 125 randomly selected specimens were studied for length-weight relationship, sex, maturity stages, feeding condition *etc.*. The fish caught by cast net ranged from 123 to 163 mm in total length with a modal length of 138 mm and average length of 137.6 mm. As the dominant size was around 138 mm, it can be presumed that the shoals belonged to 1 year class. The females constituted 96% of the total oil sardine population. All females studied were in immature stage. 98% of stomachs studied were empty and the rest were partially filled. Food items mainly consisted of green algae and diatoms indicating its surface feeding planktivorous nature. The length-weight relationship followed regression equation as

$$W = -30.8796 + 0.41699 L$$

Where W and L are the weight and length of the fish respectively.

Discussion

Enquiries from local fishermen revealed that oil sardines were of frequent occurrence during winter months and were caught along with miscellaneous catch since last 8–10 years. In the past, oil sardines could not attract fishermen's attention because of their failure to fetch good price in the local market.

Probably, economic stress in the absence of other fishery during this winter season would have led the fishermen to catch this fish. They seem to be ignorant about the utility of oil sardines in oil industries. Their ignorance resulted in the use of oil sardine as poultry feed and fish meal.

According to fishermen oil sardines do show their presence during winter months every year along the west Saurashtra coast. These shoals can either be migrating from southwest coast of India or from the offshore. Several oceanographic as well as biological factors are responsible for oil sardine migrations. The wind driven surface currents of the west coast may be one of the main factors which influence the pelagic shoals of oil sardines (Murty, *Jour. mar. biol. Ass. India*, **16** (2): 520-522, 1974). The sea water temperature and salinity also appear to significantly influence the oil sardine migrations (Suresh & Reddy, *Indian J. Fish.*, **27** (1 & 2): 1-9, 1980). To understand the proper causes and course of migration, a well planned study along the Saurashtra coast is required.

ACETES SHRIMP FISHERY OF BOMBAY COAST*

Introduction

Acetes indicus a sergestid shrimp is estimated to contribute about 20% of the marine prawn landing along the Maharashtra coast and constitutes seasonal fishery. A closer examination of these organisms have shown that three other species namely, *A. johni, A. sibogae* and *A. japonicus* are involved in the fishery. *A. sibogae* was observed to form a fishery only in estuaries.

During 1985 and 1986, weekly visits were made to three fish landing centres namely Versova, Sassoon Dock and Trombay for collection of catch data and samples for biological studies. The number of specimens examined for stomach contents were 1,215 for *A. indicus*, 1,115 for *A. johni*, 1,125 for *A. sibogae* and 212 for *A. japonicus*.

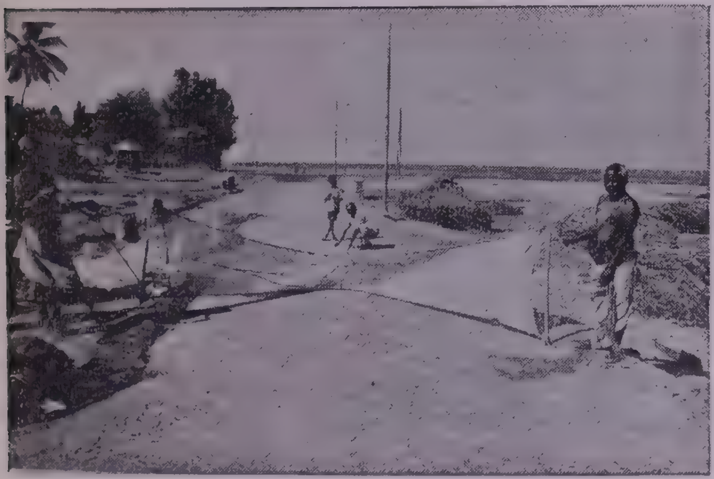

Fig. 1. 'Machardani' a gear used at Thane creek for catching *Acetes*.

The fishery

The fishery for *Acetes* is almost exclusively by bag nets ('Dol' and 'Bokshi'). 'Dol' operations are upto a depth of 40 m while 'Bokshi' nets are employed in shallower regions, mostly in creeks. A special net called 'Machardani' (Fig. 1) of mosquito net is employed for the capture of *A. sibogae* along the Thane Creek zone at 3–5 m depth. *Acetes* spp. are also caught in small quantities in the trawlers having very small cod-end mesh of about 2 cm. The fishery for *Acetes* is throughout the year at Sassoon Dock. At Versova 'Dol' operations are suspended during monsoon months. At Trombay 'Machardani' nets are not employed during this period. The average monthly landings at different centres are given in Table 1.

Table 1. *Average monthly landings of* Acetes *spp. at Versova, Sassoon Dock and Trombay* 1985–'86

Months	Place & catch (in t.)		
	Versova	S. Dock	Trombay
January	88	8	19
February	62	12	20
March	112	24	12
April	180	20	18
May	220	15	25
June	—	6	—
July	—	10	—
August	—	14	20
September	400	10	20
October	302	20	18
November	205	30	18
December	93	18	22

Table 2. *Percentage composition of* Acetes *spp. at the three centres*

Species	Versova	S. Dock	Trombay
A. indicus	49	55	2
A. johni	49	43	—
A. japonicus	2	2	3
A. sibogae	—	—	95
Total	100	100	100

It can be seen from Table 1 that landings of *Acetes* show an increasing trend just after the monsoon months at all the three centres. Another peak season is observed to be prior to the start of the monsoons. The major species that contributed to the fishery showed considerable variations in percentage. *A. sibogae* was not represented either at Versova or at Sassoon Dock. Similarly *A. johni* was not present in the 'Machardani' landings at Trombay. The predominance of *A. sibogae* at Trombay may be due to the fact that this species prefers an estuarine environment and sheltered area of the creek (Omori, *Bull. Tokyo Res. Inst.*, **7**: 1-87, 1975). *A. johni* was not noticed in Trombay landings indicating its preference for a marine habitat.

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*Prepared by M. Aravindakshan and J. P. Karbhari, Bombay Research Centre of CMFRI, Bombay.

The percentage composition of all the four species is given in Table 2. It can be seen from the Table that *A. indicus* and *A. johni* have similar percentage composition, though the percentage is a little less at Sassoon Dock. At Trombay *A. sibogae* is the dominant species, the contribution of the other species being very small.

Biological studies

A. indicus measured 13–40 mm, *A. johni* 15–28 mm, *A. japonicus* 12–25 mm and *A. sibogae* 9–33 mm. *A. sibogae* at Trombay was of smaller size, ranging from 9–22 mm mostly, though the species is known to grow upto 35 mm. This may be due to very small size of the mesh used in the fishery.

In all the four species, common items of food comprising copepods and appendages of decapod crustaceans (60%), foraminiferan and molluscan shells and shell fragments (10%), sand grains (10%) and debris (20%) were found.

Maturing females of *A. indicus* were noticed at Versova in January and of *A. johni* in March. Females of *A. sibogae* with maturing ovaries were observed in April–May indicating possible breeding during the monsoon months. In all the three species a minimum size of 13 mm was recorded for females with ripening ovary.

General considerations

According to Omori *(1975)* (*op. cit.*) the total landings of *Acetes* spp. in the world amounts to 1,30,000 tonnes on an average. This figure is considered to be the minimum by the authors as many countries do not have landing figures for *Acetes*. In India the average catch is estimated at 14,500 tonnes, constituting 11.2% of total world *Acetes* production. Major countries where a fishery for *Acetes* exists are China, India, South Korea and Thailand with China ranking first. The average life span of *Acetes* is less than six months and adult dies soon after spawning. In India only a small portion of the catch is consumed in fresh condition and the rest is mostly sun-dried. There is good demand for fresh *Acetes* in Japan where it can easily fetch a price of 300-800 Yen/kg. Considering the vast resource potential available in India, it is possible to earn considerable foreign exchange through export to countries like Japan in fresh condition.

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KERISH VIII

MARINE FISHERIES INFORMATION SERVICE

8/9/89

No. 81
MARCH 1988

Technical and Extension Series

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
COCHIN, INDIA

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

THE MARINE FISHERIES INFORMATION SERVICE: Technical and Extension Series envisages the rapid dissemination of information on marine and brackish water fishery resources and allied data available with the National Marine Living Resources Data Centre (NMLRDC) and the Research Divisions of the Institute, results of proven researches for transfer of technology to the fish farmers and industry and of other relevant information needed for Research and Development efforts in the marine fisheries sector.

Abbreviation – *Mar. Fish. Infor. Serv., T & E Ser.,* No. **81**: 1988

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5. On a whale shark *Rhiniodon typus* Smith landed at Pudumanaikuppam, Madras

6. On the capture of a giant sized Indian threadfin *Polynemus indicus* Shaw at Satpati, Maharashtra coast

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Front cover photo:

Scomberomorus guttatus.

Back cover photo:

A general view of the fish landing centre at Puthiappa, Calicut.

MARINE FISH CALENDAR

3. CALICUT*

M. Kumaran, T. M. Yohannan and Feroz Khan
Calicut Research Centre of CMFRI, Calicut

Introduction

Investigations on the resource characteristics of some commercially important pelagic as well as demersal fishes, prawns and molluscs are being carried out at the Calicut Research Centre of Central Marine Fisheries Research Institute. The Kerala coast being an important contributor of major species of pelagic fish resources like oil sardine and mackerel, emphasis is given on the investigations of potential stocks of the above resources. Resource characteristics of pelagic fishes like tuna, seer fish, bill fish, pomfret and demersal fishes like cat fish, sole *etc.* are also being regularly monitored for distribution and abundance in space and time.

The major portion of the fish landed at the Calicut fish landing centre is that exploited by country crafts with indigenous gears like boat seines, drift net, gill net and hooks and line and only 13.2% (800 tonnes) is by trawling by mechanised boats. Analysis of the fish landings for the years 1981–'86 shows that the average total landing was 6,053.5 tonnes of which about 70% (4,235.2 tonnes) was by boat seines alone, drift net contributing 6.6% (401.4 tonnes), hooks and line 5.8% (350.1 tonnes) and gill net 4.4% (266.8 tonnes). In the drift net catches the CPUE of different species are found to be maximum during July. This being the peak monsoon month, the effort is generally very low. Perhaps this can be the reason for high CPUE values. Still the possibility of increased availability of these species during the monsoon months cannot be ruled out as drift net units do not venture to go for fishing during monsoon due to bad weather.

The important groups contributing to the fishery at Calicut are clupeids (3,322 tonnes), anchovies (383 tonnes), seer fishes, mackerel and tunas (363 tonnes), soles (291 tonnes), cat fishes (257 tonnes), pomfrets (65 tonnes) and elasmobranchs (26 tonnes).

Clupeids forming 54.9% are exploited by boat seines which contribute 96.1% and the gill net which contributes 3.9% of the total clupeid landings. The annual yield of oil sardine *Sardinella longiceps* which is the most important species among clupeids having wide fluctuations from year to year and with an average of 3,288 tonnes, has been showing generally a declining trend in recent years. Fishes of 0-year class contribute to a major portion of the catch. As maturity progresses to a size of 14 cm, with the onset of the monsoon there is a seaward breeding migration. The fishery being restricted to the narrow coastal belt extending to about 10 km from the shore is exclusively exploited by artisanal fishermen using indigenous crafts and gears. The gradual decline in the yield along the Malabar coast may be attributed to the widespread operation of purse seiners along both south and north of this part of the coast as it restricts movement of shoals and adversely affects spawning.

Anchovies forming 6.3% in the total landings are exploited by boat seines (83.6%) and trawl net (16.4%).

Scombroids which form 6.0% in the total catch are exploited mostly by drift net (45.3%), boat seines (34.4%) and gill net (19.9%). The Indian mackerel *Rastrelliger kanagurta* forming 208.8 tonnes on an average is exploited by gill net, boat seines and drift net. This resource also shows wide fluctuations in the yield with a maximum catch of 709 tonnes in 1980 which gradually declined in 1983. The yield trend in the subsequent years steadily improved with a crust in 1985 (385 tonnes). The peak fishing season for mackerel which occurs from 5 to 40 m depth is from August to October. Seerfishes *Scomberomorus commerson* and *S. guttatus* contributing 89.6 tonnes per year on an average are mainly landed by drift net. The peak period of abundance is from October to December,

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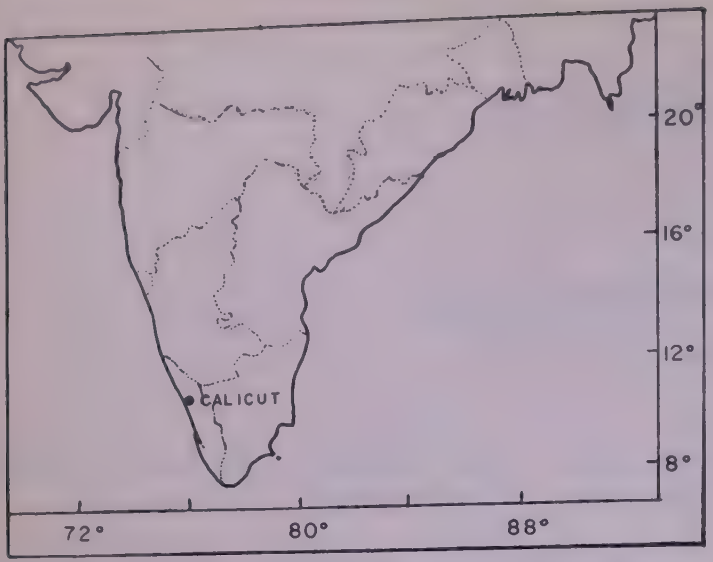
*Consolidated by N. Gopinatha Menon and K. Balachandran, CMFRI, Cochin.



but the spawning is during April–May. The average annual catch of tunas is 64.2 tonnes which are exclusively landed by drift net. The dominant species is the little tunny *Euthynnus affinis* and the fishing season extends from March to May. Fairly offshore waters from 30–50 m is the region of abundance of tunas.

Soles form on an average 4.8% in the total landings and is exploited by trawl net, boat seine and gill net and the most important commercial species is the Malabar sole *Cynoglossus macrostomus.*

Cat fish forming 4.3% in the total landings is an important component in the demersal fishery resources and is exploited by hooks and line, drift net and trawl net. *Tachysurus dussumieri, T. thalassinus, T. tenuispinis* and *T. serratus* are the most important species forming the commercial fishery. Cat fish constitutes 57.0% in the landings of hooks and line and 15.2% in drift net landings. The trend of this resource showed fluctuations from year to year with a general decreasing trend in the past one or two years. The peak period of the fishery generally coincides with the peak breeding season, often with mass destructions of gestating males leading to mass mortality of eggs/embryos.

The pomfrets forming 1.1% of the total landings are exploited by drift net, boat seine and trawl net. The black pomfret *Parastromateus niger* and silver pomfret *P. argenteus* are the species involved and the former forms about twice that of the latter in the fishery. Pomfrets constitute 9.0% in the landings of drift net, 0.8% in the trawl net and 0.5% in boat seines.

Sharks, skates and rays together form only 0.42% in the total landings and are mainly landed by hooks and line and drift net. Other demersal resources like ribbon fishes, threadfin breams, sciaenids, silver bellies and lizard fishes also form a fishery of some importance in the Calicut region.

CLUPEIDAE

Popular English Name	:	Sardines
Vernacular Name (Malayalam)	:	'Mathi'/'Chala'/ 'Mathichala'
Annual average catch	:	3,322 t
Percentage in total catch	:	54.88
Fishing methods and their contribution	:	Boat seine/Gill net Boat seine : 96.09% Gill net : 3.91%

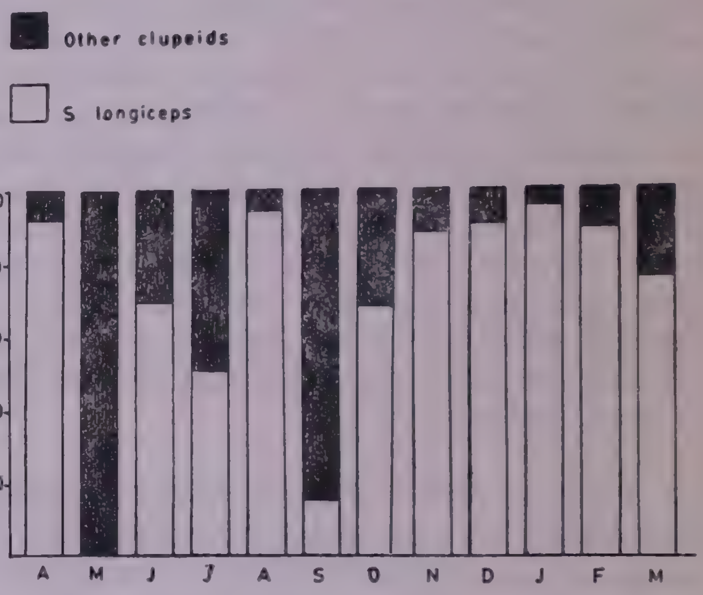


Fig. 1. Monthwise species composition of clupeids by gill net.

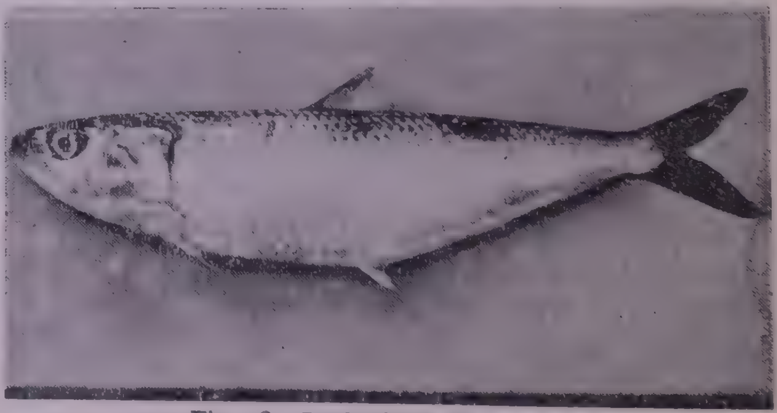


Fig. 2. *Sardinella longiceps.*

Scientific Name	:	*Sardinella longiceps*
Vernacular Name	:	'Mathi'
Gear	:	Boat seine/Gill net
Percentage composition in the gear	:	Boat seine : 74.85 Gill net : 39.43
Peak period of occurrence	:	Sept. – Feb.
Depth of occurrence	:	5 – 15 m

Length range in commercial fishery : 130 – 210 mm
Size at first maturity : 140 mm
Spawning season : Jun. – Aug.

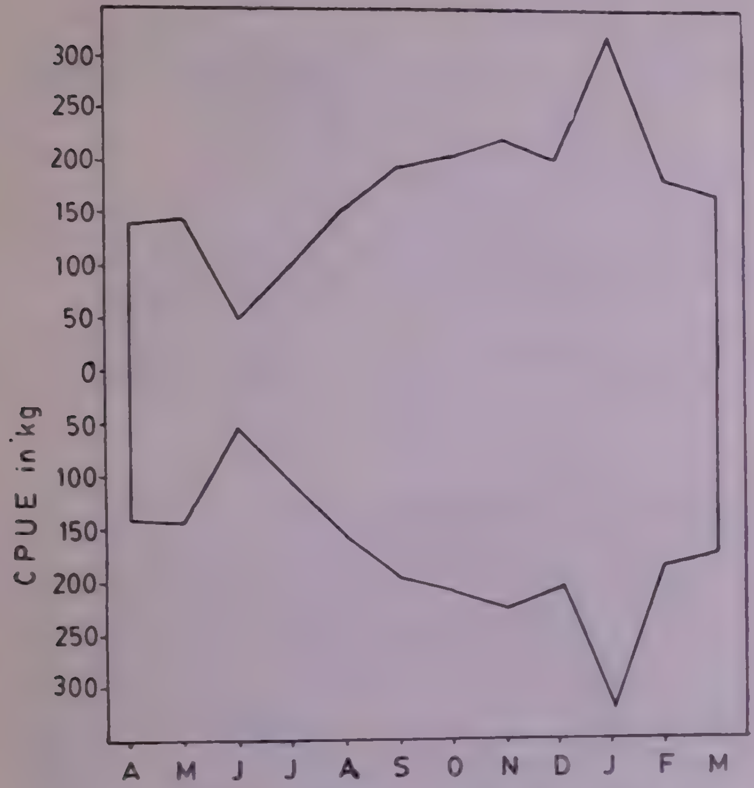


Fig. 3. Seasonal abundance of oil sardine in boat seine.

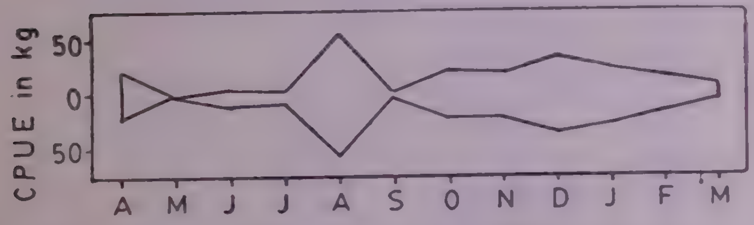


Fig. 4. Seasonal abundance of oil sardine in gill net.

CYNOGLOSSIDAE

Popular English Name : Sole/Tongue sole/ Malabar sole
Vernacular Name (Malayalam) : 'Mantha'
Annual average catch : 290.9 t
Percentage in total catch : 4.8
Fishing methods and their contribution : Trawl net/Boat seine/ Gill net

Trawl net	:	90.87%
Boat seine	:	6.72%
Gill net	:	2.41%

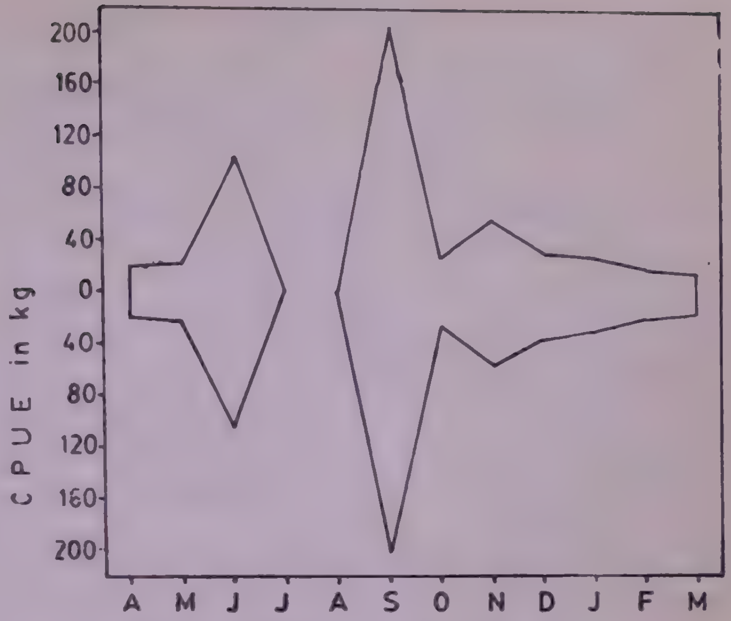


Fig. 5. Seasonal abundance of cynoglossids in trawl net.

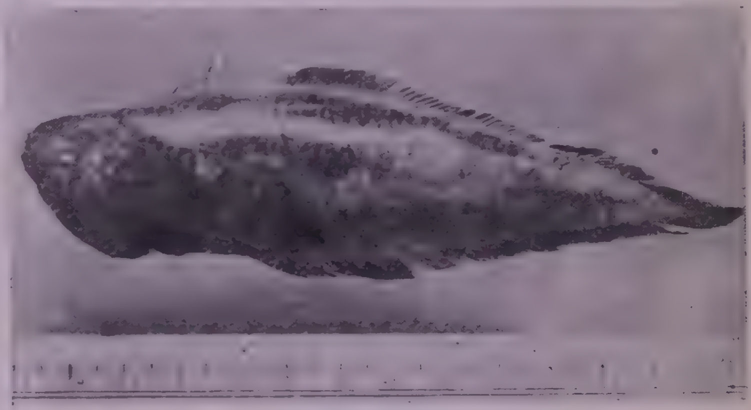


Fig. 6. *Cynoglossus macrostomus.*

Scientific Name : *Cynoglossus macrostomus*
Vernacular Name : 'Mantha'
Gear : Trawl net/Boat seine/ Gill net
Percentage composition in the gear :

Trawl net	:	33.00
Gill net	:	2.41
Boat seine	:	0.46

Peak period of occurrence : Nov. - Feb.
Depth of occurrence : Upto 10 m
Length range in commercial fishery : 40 – 160 mm
Size at first maturity : 120 mm
Spawning season : Oct. – Jan.

ELASMOBRANCHS

Popular English Name : Sharks/Skates/Rays
Vernacular Name (Malayalam) : 'Sravu'/'Koithala'/ 'Thirandi'
Annual average catch : 25.69 t

Percentage in total catch : 0.42
Fishing methods and their contribution : Hooks and line/Drift net
Hooks and line : 93.44%
Drift net : 6.56%

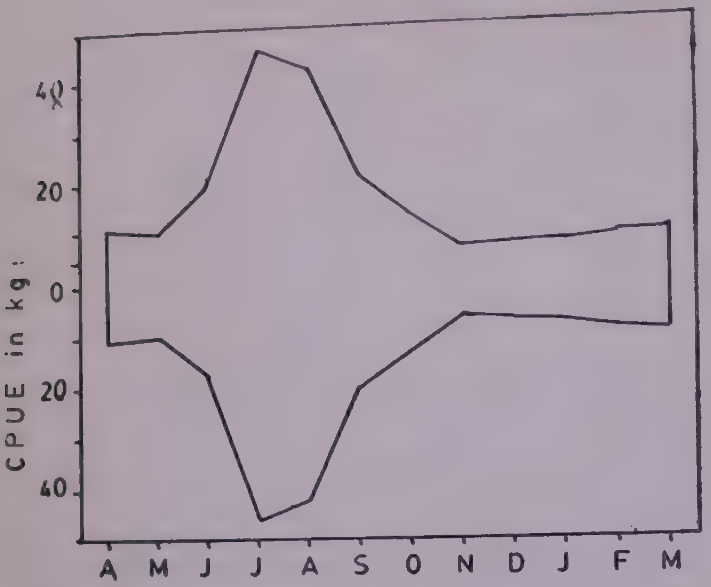


Fig. 7. Seasonal abundance of elasmobranchs in drift net.

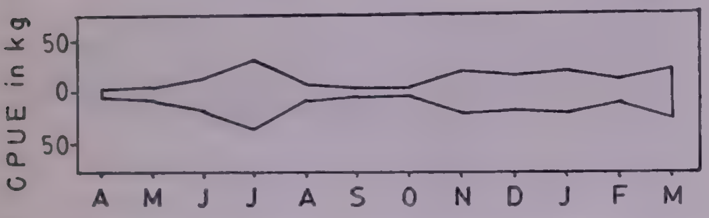


Fig. 8. Seasonal abundance of elasmobranchs in hooks and line.

ENGRAULIDAE

Popular English Name : Anchovy
Vernacular Name (Malayalam) : 'Nethal'/'Netholi'
Annual average catch : 383.27 t
Percentage in total catch : 6.33
Fishing methods and their contribution : Boat seine/Trawl net
Boat seine : 83.6%
Trawl net : 16.4%

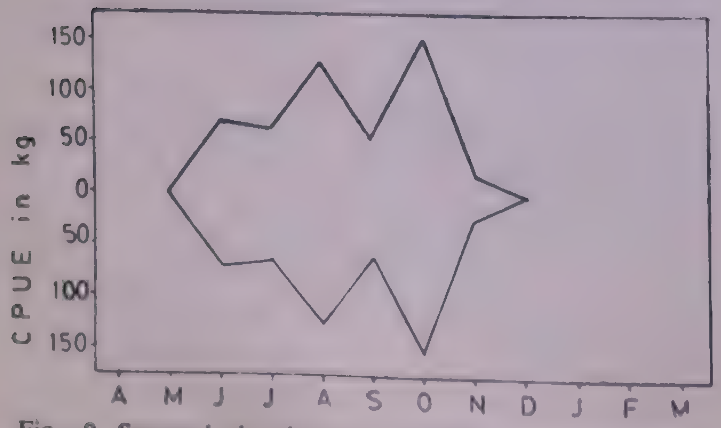


Fig. 9. Seasonal abundance of Engraulidae in boat seine.

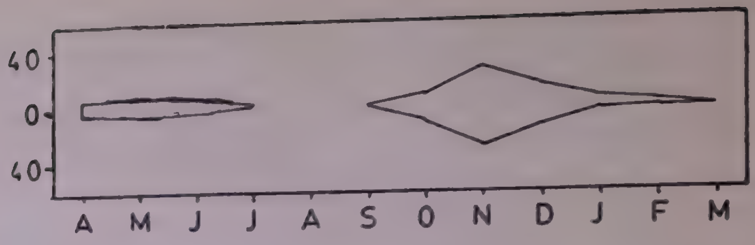


Fig. 10. Seasonal abundance of Engraulidae in trawl net.

SCOMBRIDAE

Popular English Name : Seer fishes/Indian mackerel/Tunas
Vernacular Name (Malayalam) : 'Ayakkura'/'Ayila'/'Sootha'/'Varimeen'/'Choora'
Annual average catch : 362.7 t
Percentage in total catch : 5.99
Fishing methods and their contribution : Drift net/Boat seine/Gill net/Trawl net
Drift net : 45.32%
Boat seine : 34.42%
Gill net : 19.88%
Trawl net : 0.39%

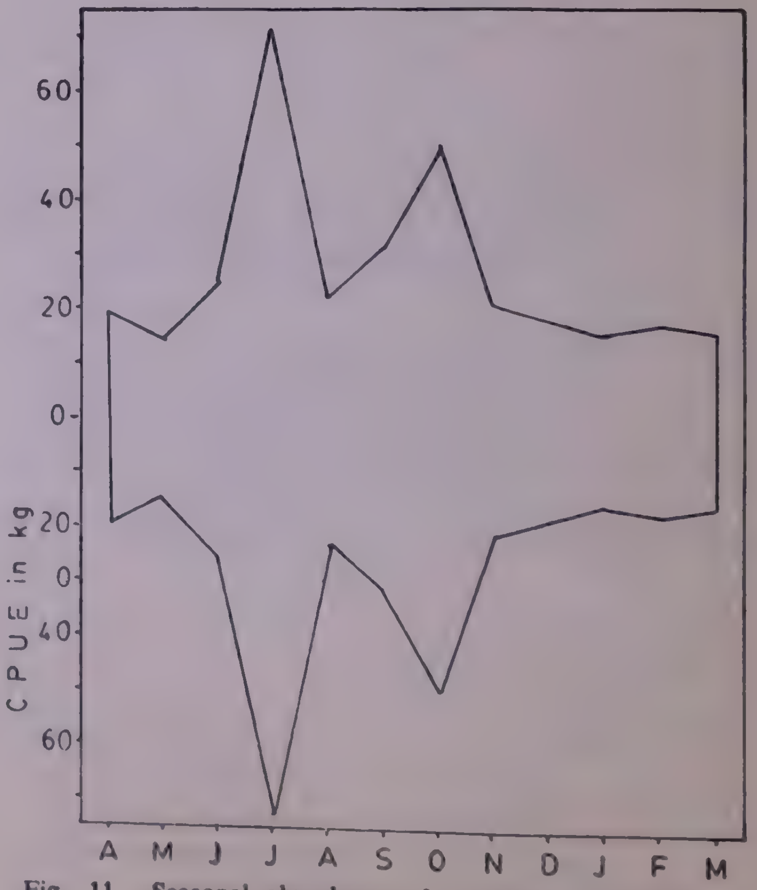


Fig. 11. Seasonal abundance of scombroids in drift net.

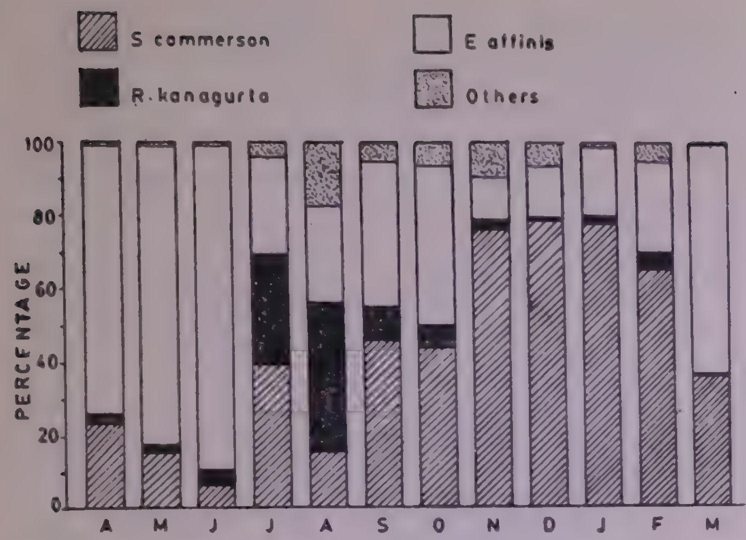


Fig. 12. Monthwise species composition of scombroids in drift net.

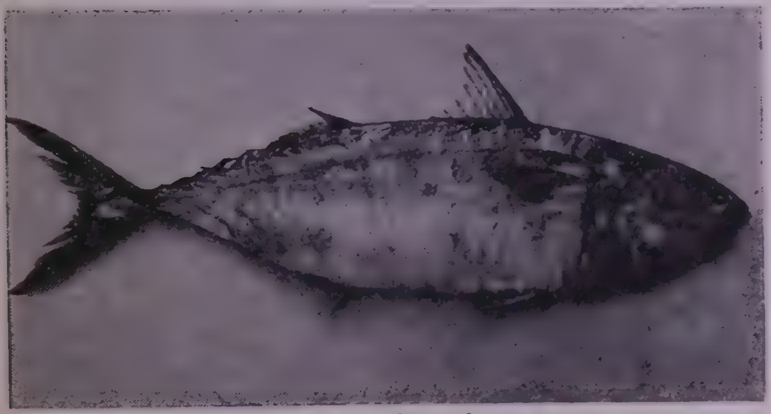


Fig. 13. *Rastrelliger kanagurta.*

Scientific Name : *Rastrelliger kanagurta*
Vernacular Name (Malayalam) : 'Ayila'
Gear : Gill net/Boat seine/ Drift net
Percentage composition in the gear :
- Gill net : 27.02
- Boat seine : 2.98
- Drift net : 2.62

Peak period of occurrence : Aug. – Oct.
Depth of occurrence : 5 – 40 m

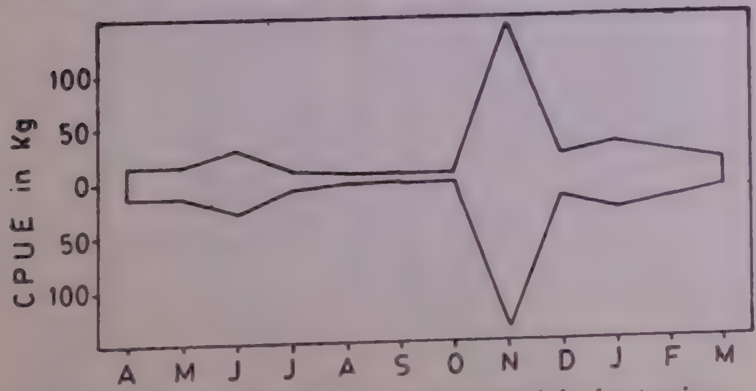


Fig. 14. Seasonal abundance of mackerel in boat seine.

Length range in commercial fishery : 180 – 220 mm
Size at first maturity : 200 mm
Spawning season : May to August.

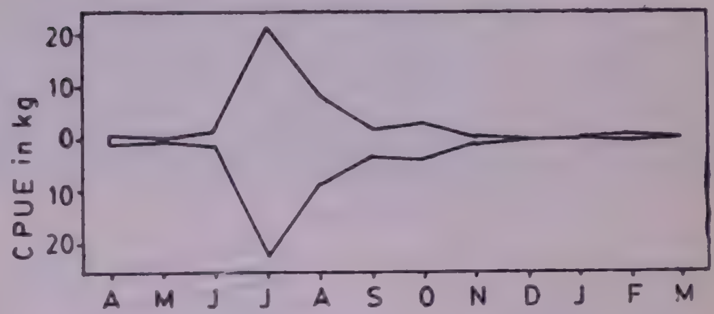


Fig. 15. Seasonal abundance of mackerel in drift net.

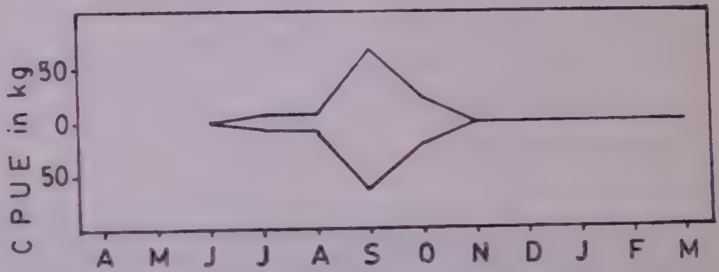


Fig. 16. Seasonal abundance of mackerel in gill net.

SEER FISHES

Popular English Name : Seer fishes
Vernacular Name (Malayalam) : 'Varimeen'/'Ayakkura'
Annual average catch : 89.6 t
Percentage in total catch : 22.3
Fishing methods and their contribution : Drift net

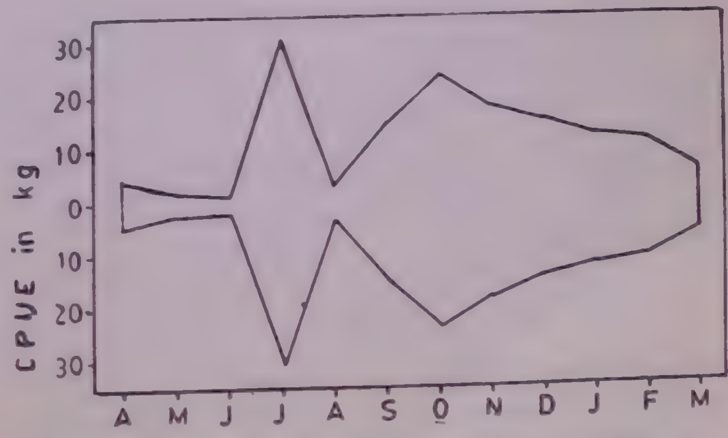


Fig. 17. Seasonal abundance of seer fishes in drift net.

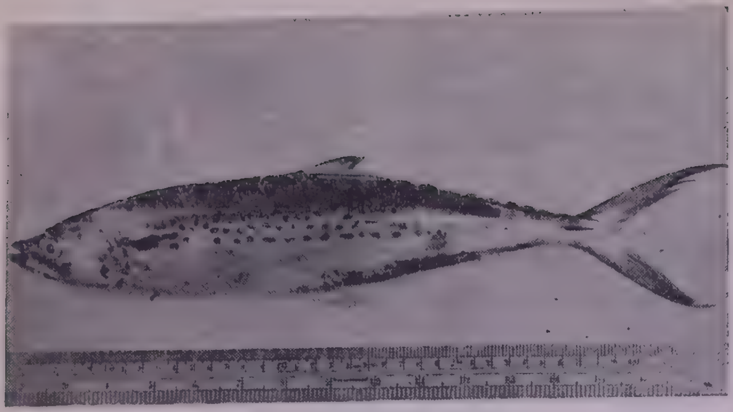


Fig. 18. *Scomberomorus guttatus.*

Scientific Name : *Scomberomorus guttatus*
Vernacular Name : 'Varimeen'
Gear : Drift net
Percentage composition in the gear : Drift net : 1.04
Peak period of occurrence : Oct. – Nov.
Depth of occurrence : 20 – 50 m
Length range in commercial fishery : 300 – 600 mm
Size at first maturity : 410 mm
Spawning season : April – May

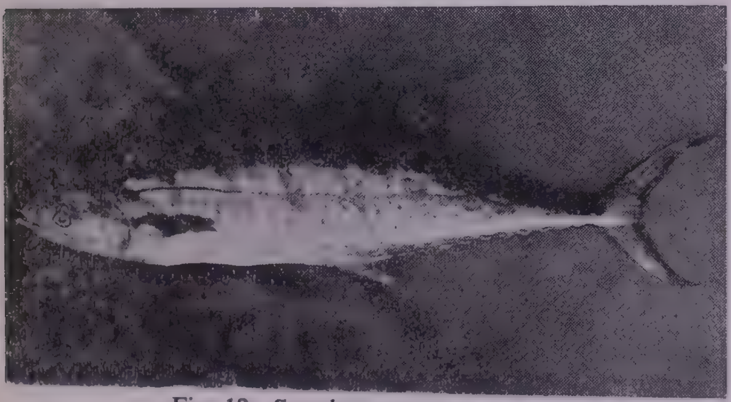


Fig. 19. *Scomberomorus commerson.*

Scientific Name : *Scomberomorus commerson*
Vernacular Name : 'Ayakkura'
Gear : Drift net
Percentage composition in the gear : Drift net : 21.30
Peak period of occurrence : Oct. – Dec.
Depth of occurrence : 20 – 50 m
Length range in commercial fishery : 500 – 800 mm
Size at first maturity : 750 mm
Spawning season : April – May

TUNA

Popular English Name : Tuna
Vernacular Name (Malayalam) : 'Sootha'/'Choora'
Annual average catch : 64.2 t
Percentage in total catch : —
Fishing methods and their contribution : Drift net : 16%

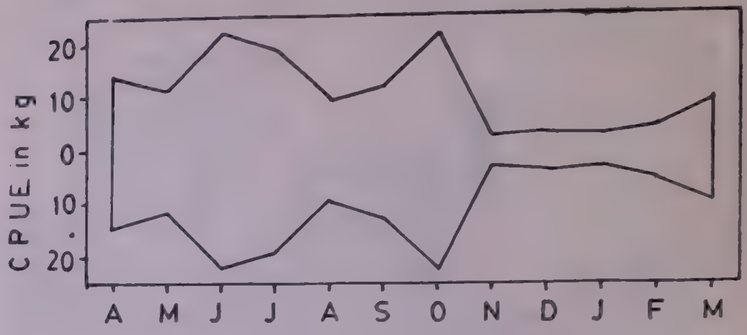


Fig. 20. Seasonal abundance of tunas in drift net.

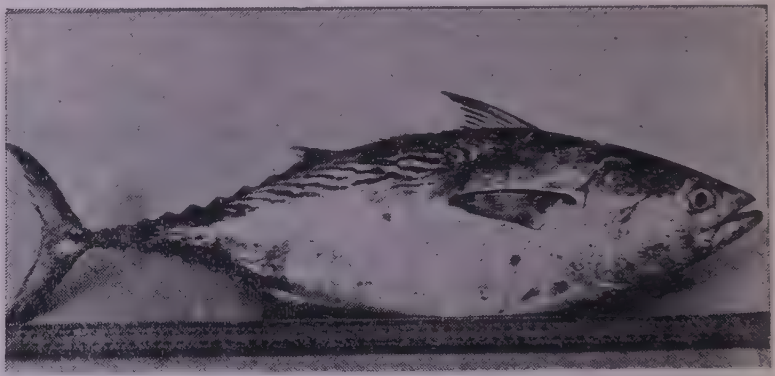


Fig. 21. *Euthynnus affinis.*

Scientific Name : *Euthynnus affinis*
Vernacular Name : 'Sootha'/'Choora'
Gear : Drift net
Percentage composition in the gear : Drift net : 14.94
Peak period of occurrence : March – May
Depth of occurrence : 30 – 50 m
Length range in commercial fishery : 300 – 500 mm
Size at first maturity : 430 mm
Spawning season : Sep. – Oct.

STROMATEIDAE

Popular English Name : Black pomfret/Silver pomfret
Vernacular Name (Malayalam) : 'Avoli'
Annual average catch : 64.7 t
Percentage in total catch : 1.07
Fishing methods and their contribution : Drift net/Boat seine/Trawl net
Drift net : 55.76%
Boat seine : 33.47%
Trawl net : 10.77%

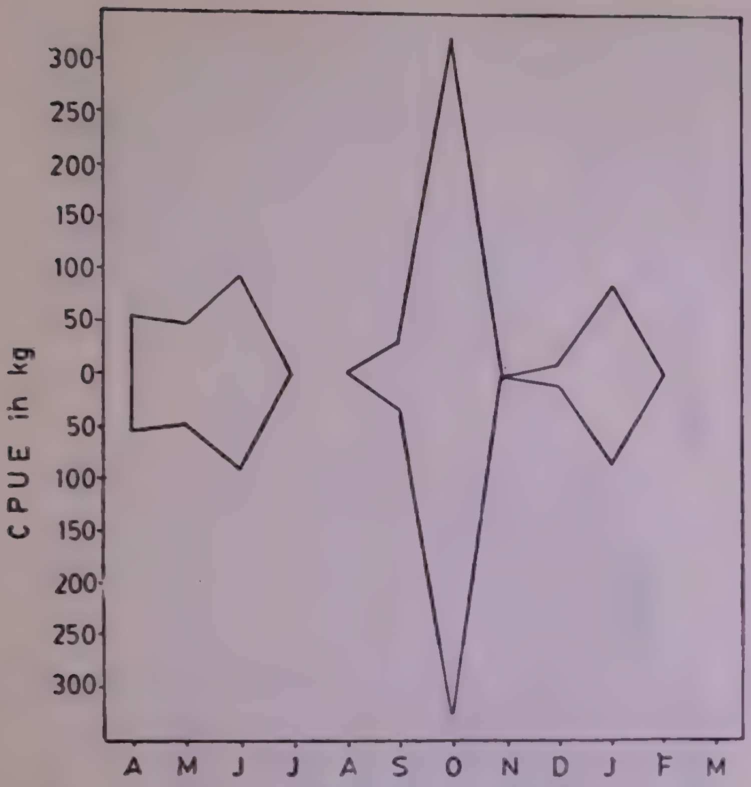


Fig. 22. Seasonal abundance of pomfrets in boat seine.

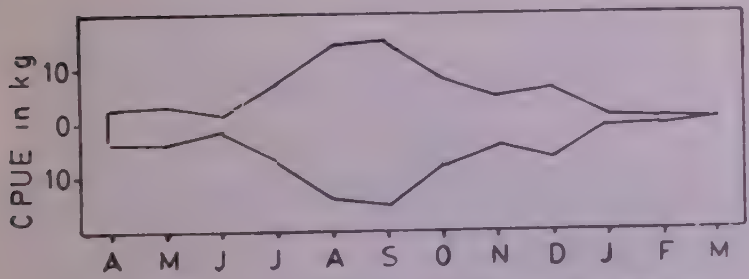


Fig. 23. Seasonal abundance of pomfrets in drift net.

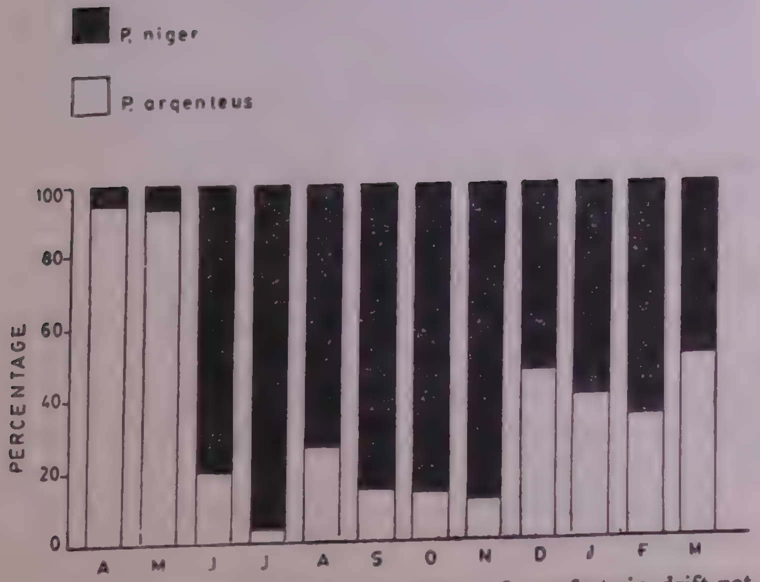


Fig. 24. Monthwise species composition of pomfrets in drift net.

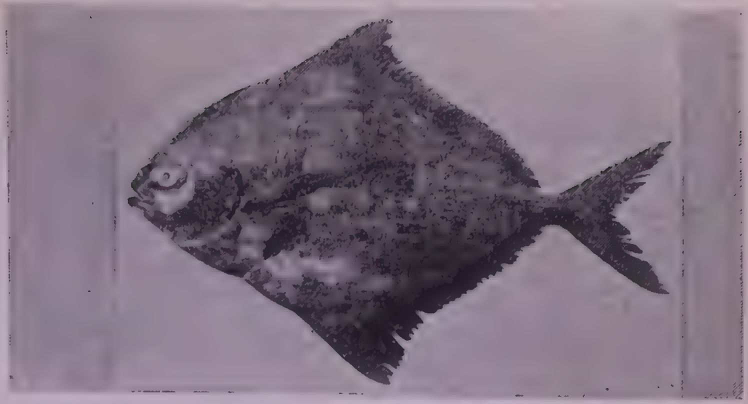


Fig. 25. *Parastromateus niger.*

Scientific Name : *Parastromateus niger*
Vernacular Name : 'Karutha avoli'
Gear : Drift net/Boat seine
Percentage composition in the gear : Drift net : 6.06
Boat seine : 0.51
Peak period of occurrence : Sep. – Dec.
Depth of occurrence : 15 – 40 m
Length range in commercial fishery : 230 – 350 mm
Size at first maturity : 300 mm
Spawning season : July – Oct.

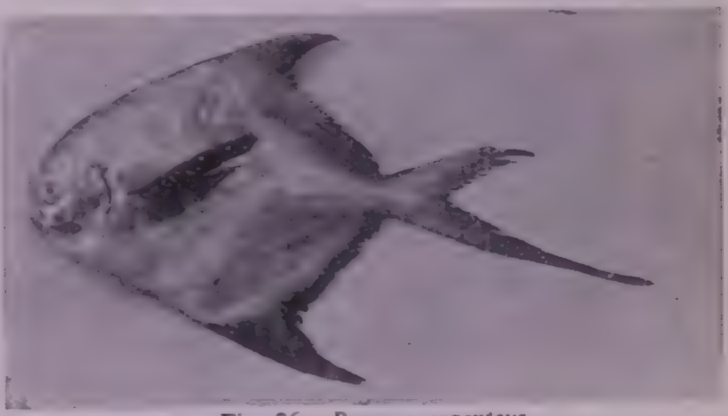


Fig. 26. *Pampus argenteus.*

Scientific Name : *Pampus argenteus*
Vernacular Name : 'Vella avoli'
Gear : Drift net/Trawl net
Percentage composition in the gear : Drift net : 2.92
Trawl net : 0.85
Peak period of occurrence : Nov. – Jan.
Depth of occurrence : 10 – 40 m
Length range in commercial fishery : 160 – 250 mm
Size at first maturity : 220 mm
Spawning season : May – Sep.

TACHYSURIDAE

Popular English Name : Cat fish
Vernacular Name (Malayalam) : 'Etta'
Annual average catch : 257.18 t (1981 – '86)
Percentage in total catch : 4.3

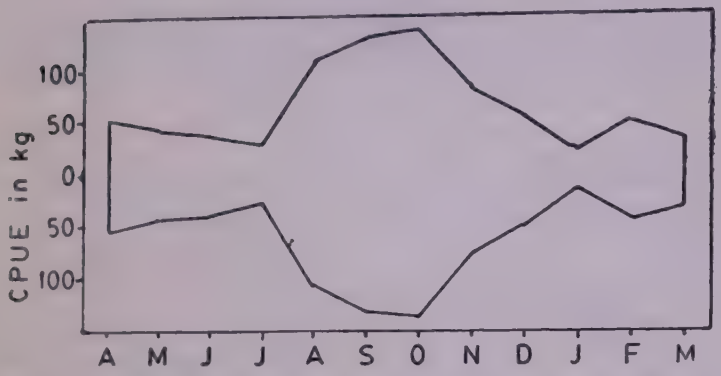


Fig. 27. Seasonal abundance of cat fishes in hooks and line.

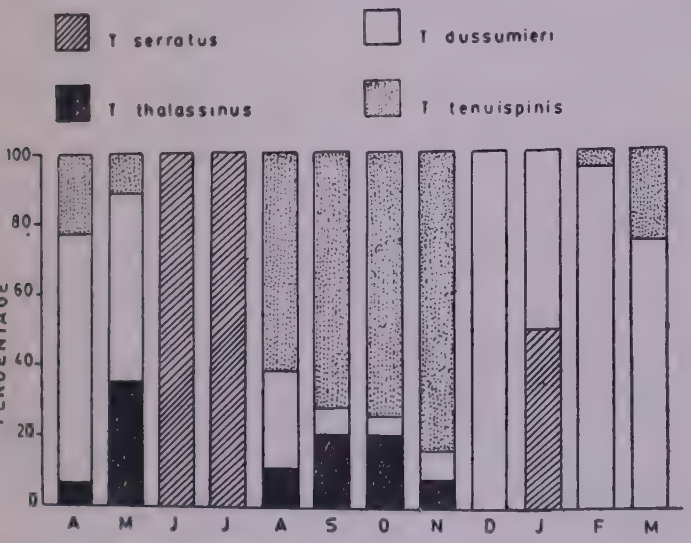


Fig. 28. Monthwise species composition of cat fishes in hooks and line.

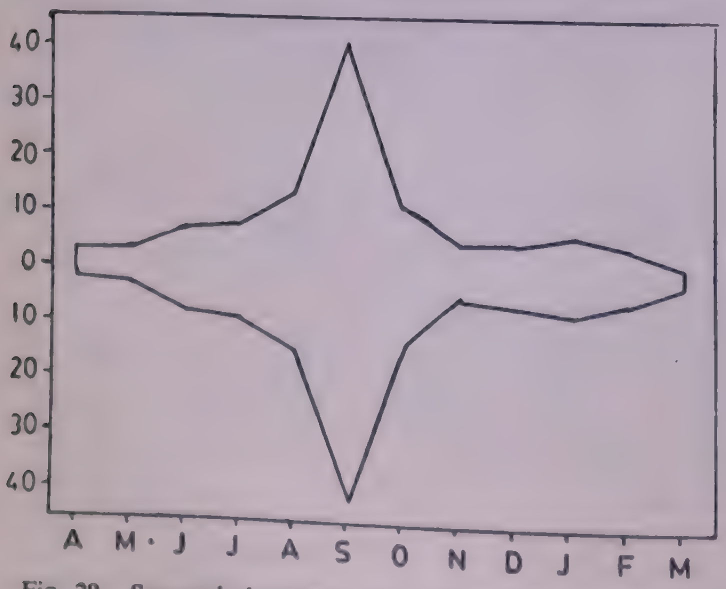


Fig. 29. Seasonal abundance of cat fishes in drift net.

Fishing methods and their contribution : Hooks and line/Drift net/Trawl net
Hooks and line : 73.08%
Drift net : 23.14%
Trawl net : 3.78%

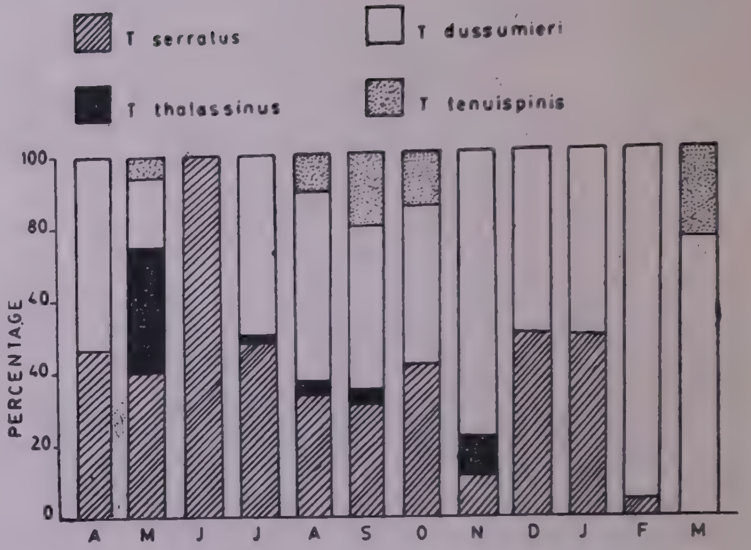


Fig. 30. Monthwise species composition of cat fishes in drift net.

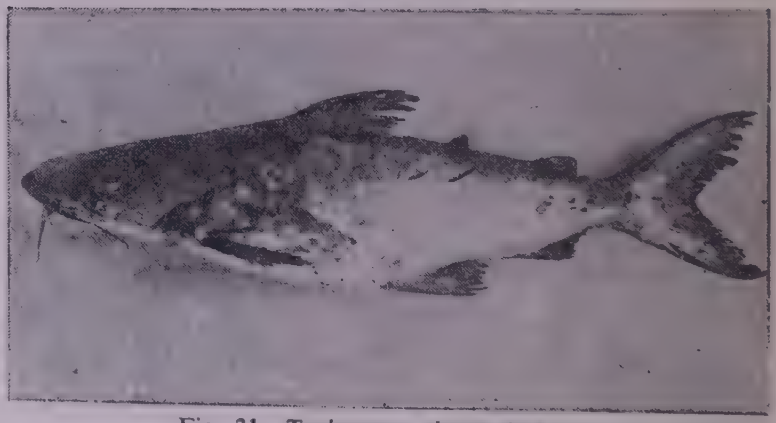


Fig. 31. *Tachysurus dussumieri.*

Scientific Name : *Tachysurus dussumieri*
Vernacular Name : 'Valiyetta'
Gear : Hooks and line/Drift net
Percentage composition in the gear : Hooks and line : 14.89
Drift net : 5.91
Peak period of occurrence : Mar. – May
Depth of occurrence : 15 – 40 m
Length range in commercial fishery : 500 – 1,000 mm
Size at first maturity : 500 mm
Spawning season : April – Aug.

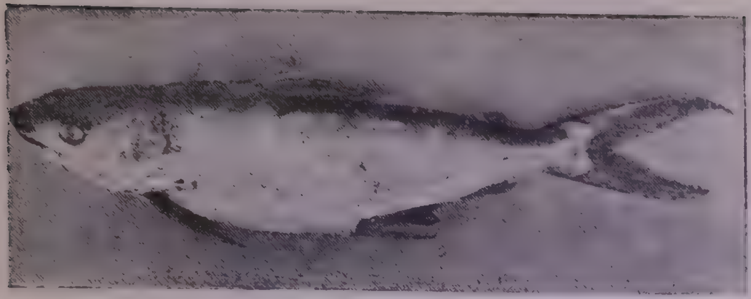


Fig. 32. *Tachysurus thalassinus.*

Scientific Name : *Tachysurus thalassinus*
Vernacular Name : 'Thuriyetta'
Gear : Hooks and line/Drift net
Percentage composition in the gear : Hooks and line : 11.11
Drift net : 0.27
Peak period of occurrence : Aug. – Oct.
Depth of occurrence : 25 – 60 m
Length range in commercial fishery : 170 – 600 mm
Size at first maturity : 280 mm
Spawning season : Apr. – Aug.

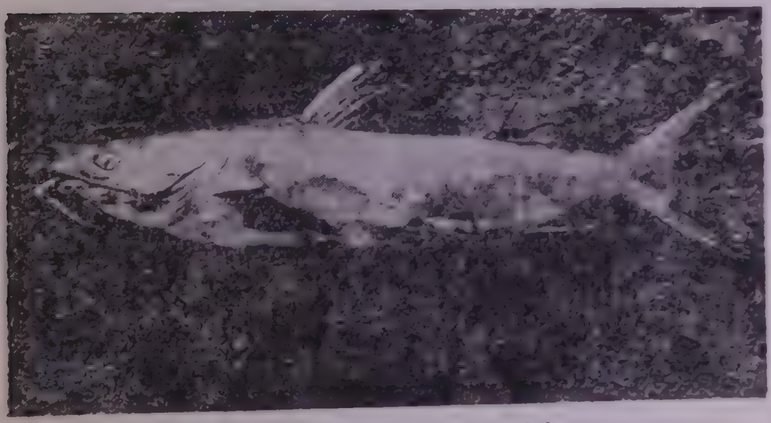


Fig. 33. *Tachysurus tenuispinis.*

Scientific Name : *Tachysurus tenuispinis*
Vernacular Name : —
Gear : Hooks and line/Drift net/Trawl net
Percentage composition in the gear : Hooks and line : 27.46
Drift net : 7.15
Trawl net : 1.22
Peak period of occurrence : Sep. – Mar.
Depth of occurrence : 35 – 60 m
Length range in commercial fishery : 230 – 400 mm
Size at first maturity : 280 mm
Spawning season : May – Sep.

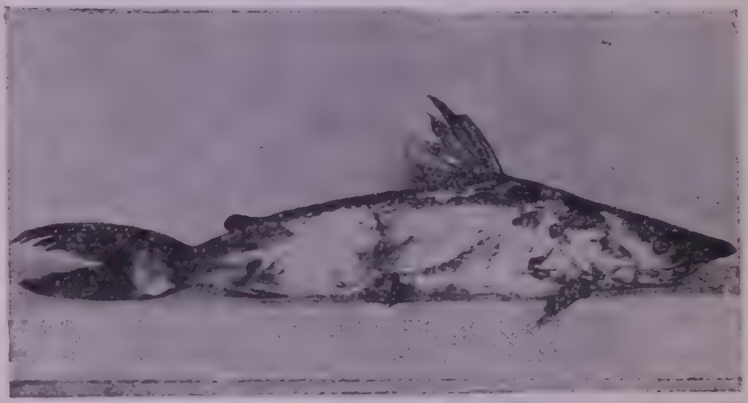


Fig. 34. *Tachysurus serratus.*

Scientific Name : *Tachysurus serratus*
Vernacular Name : 'Navetta'
Gear : Hooks and line/Drift net
Percentage composition in the gear : Hooks and line : 3.50
Drift net : 1.82
Peak period of occurrence : Sep. – Dec.
Depth of occurrence : 25 – 40 m
Length range in commercial fishery : 600 – 1,000 mm
Size at first maturity : 600 mm
Spawning season : April – July

POTENTIALITIES OF MUTTUKADU MARICULTURE FARM FOR GREEN MUSSEL CULTURE*

Experimental pole culture and culture trials using nylon bags were attempted for green mussel *Perna viridis* at Muttukadu Mariculture Farm of CMFRI (Lat. 12°48′ N; Long. 80°15′ E), located near Madras.

Pole culture experiment

Seventy five teak wood poles, each measuring 3.5 m in height were used for the experiment. Each pole was driven to a depth of 0.5 m in the mud, leaving 3.0 m height above substratum. They were arranged at the northern end of the farm, where the depth ranged from 1.5 to 2.0 m, depending on the tides. On an average, 4.02 kg of seed of *P. viridis*, ranging in length from 15.0 to 53.0 mm (26.6 mm in mean length and 2.05 g in mean weight), were collected from Ennore and were packed in 2 m long cotton bags (Fig. 1). A single bag was tied around each pole, and care was taken to keep the bag well below the low water mark. With the disintegration of the cotton bags in a fortnight's time, the seed gained attachment to poles by byssus threads (Fig. 2).

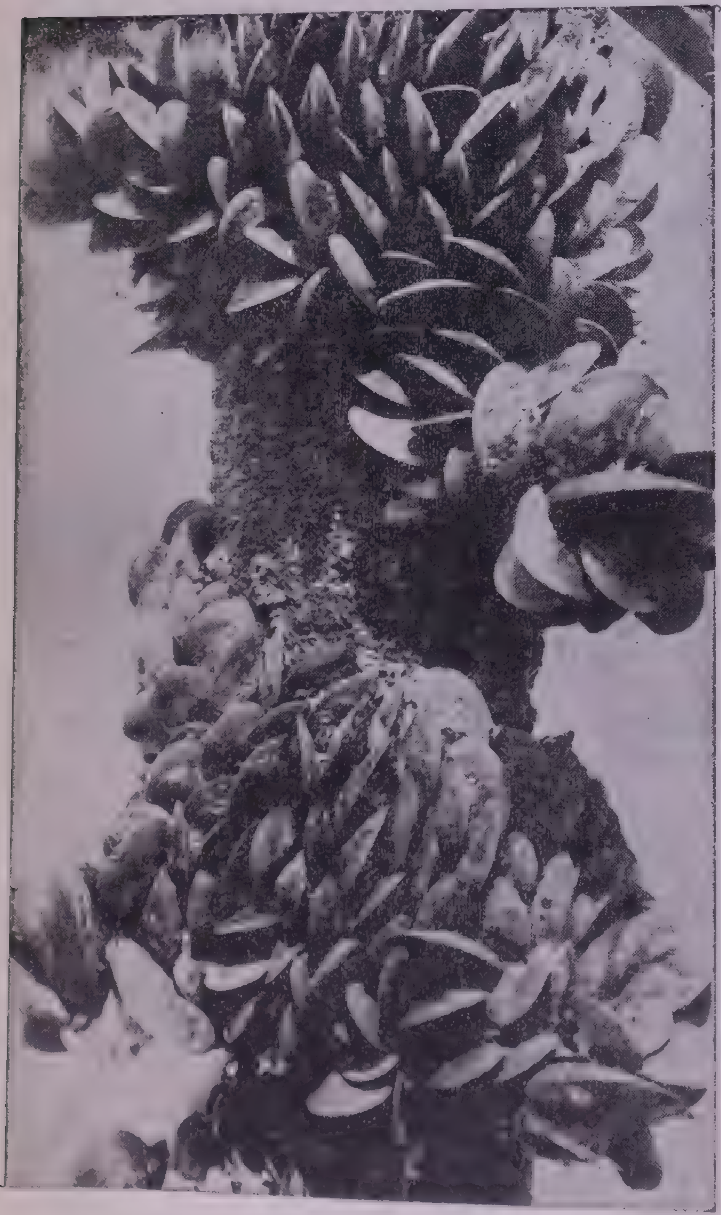


Fig. 1. Mussel attached to poles.

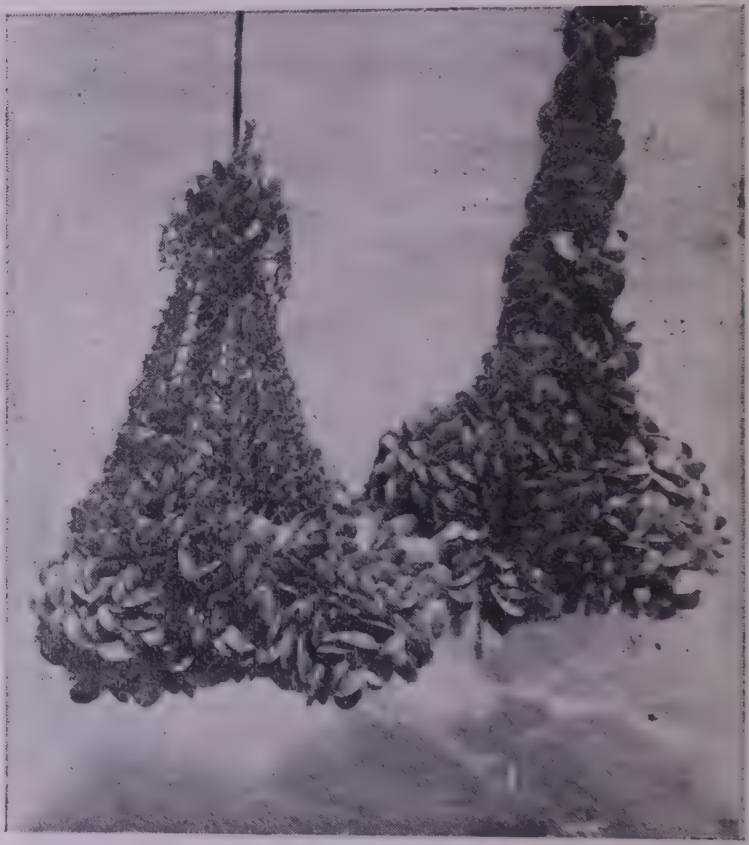


Fig. 2. Growth of mussel in bags.

Bag culture trials

In another experiment, 39 bags, each of 35 x 40 cm size, made of nylon webbings (15 mm mesh size), were seeded with an average of 3.2 kg of seed. They were suspended from a fixed woodencraft (5 x 5 m size), by nylon ropes of 1 m length. The water depth in the area was 1.5 to 2.0 m. The mussel stock was found to grow well, attaching themselves to one another (Fig. 3).

Seeding operations in both cases were done in August, 1986 and the harvest was carried out in

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*Prepared by P. V. Sreenivasan, R. Thangavelu and P. Poovannan, Madras Research Centre of CMFRI, Madras.

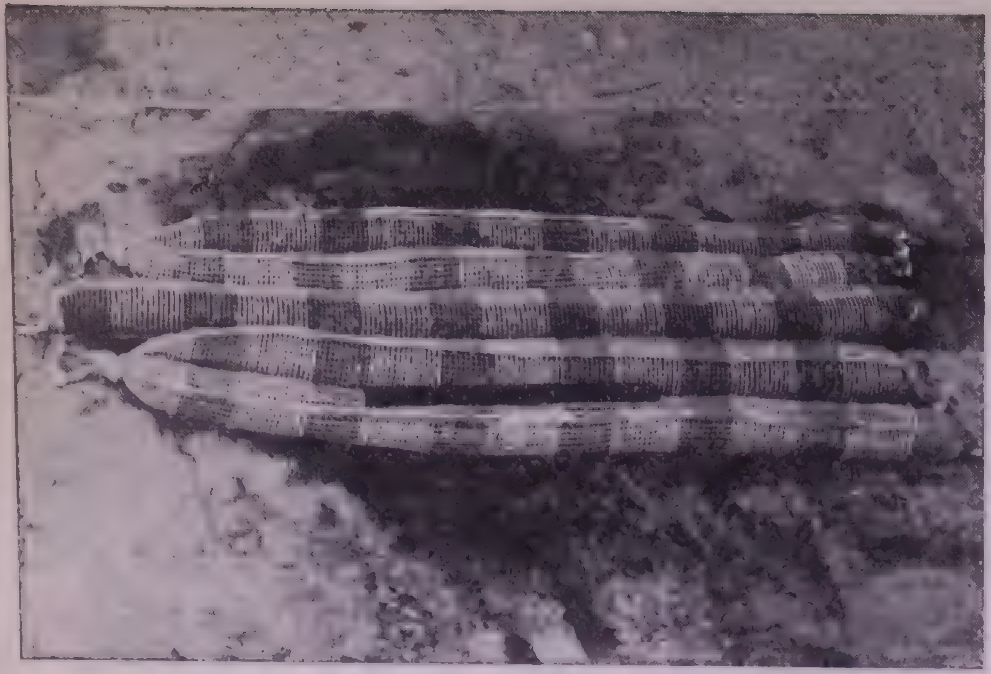

Fig. 3. Mussel seed packed in cotton bags (4.02 kg in 2 m length bag).

Fig. 4. Loading of mussel into the canoe.

Fig. 5. Unloading of mussel from the canoe.

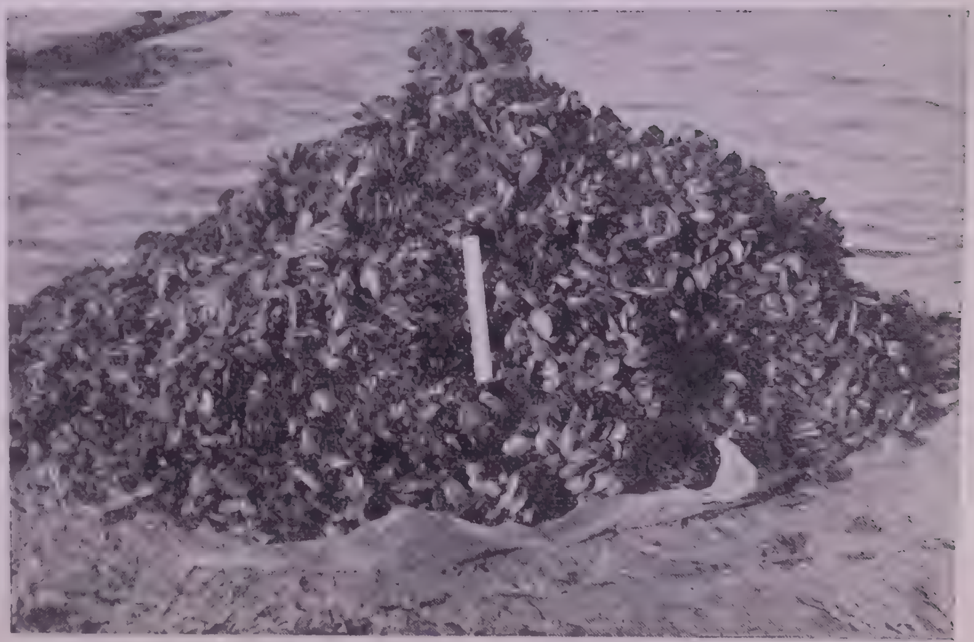

Fig. 6. Harvested mussel from poles (about 1 tonne).

February. During this period, the salinity in the culture site ranged from 17.59‰ (in November) to 40.51‰ (in September) and was around 30‰ in most of the months. Surface temperature varied from 23.8 to 33.8 °C, while dissolved oxygen ranged from 2.98 to 6.66 ml/l. Details regarding the quantity of mussel harvested, net increase in weight and average quantity obtained/unit are given in Table 1 and the process of harvest is shown in Figs. 4 to 6.

Table 1. *Details regarding seeding and harvesting of the green mussel* Perna viridis, *at Muttukadu backwaters*

Particulars	Poles	Bags
Total units seeded	75	39
Seed used (kg)	4.02 /pole	3.2 /bag
Total quantity of seed used (kg)	301.5	121.9
Total units harvested	69	33
Total quantity harvested (kg)	963.9	595.0
Net increase (kg)	662.4	473.1
Average quantity of mussel/unit (kg)	13.96	18.05
Net increase/Unit (kg)	9.94	14.83
Maximum quantity harvested from a single unit (kg)	42.50	43.00

Growth of *P. viridis*, in length and weight, in the six months period is depicted in Figs. 7 and 8. There was an increase of 51.4 and 47.9 mm in length among mussel from poles and bags respectively, from a common mean seed size of 26.6 mm. Correspondingly, the increase in weight was from 2.05 to 40.55 g in the case of poles and to 34.47 g in bags.

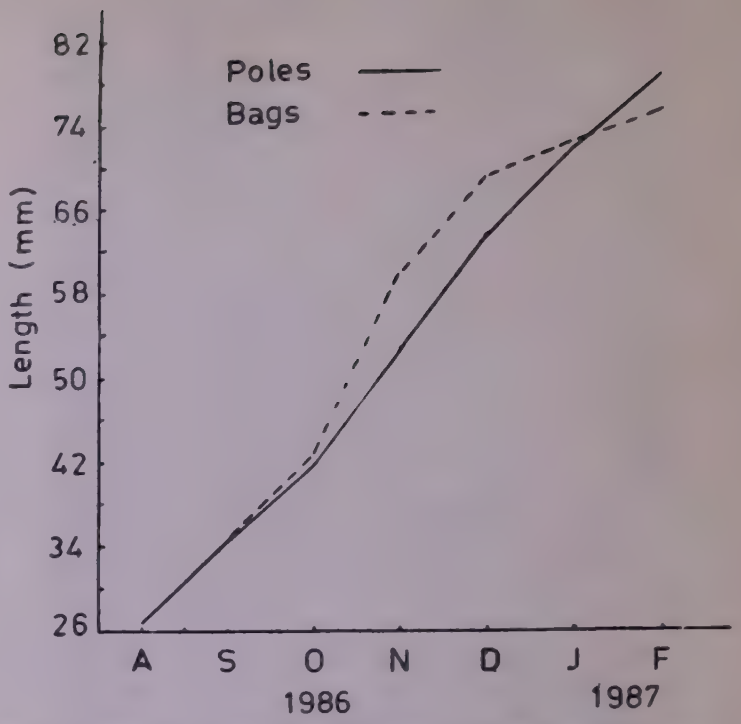

Fig. 7. Growth in length of *P. viridis* on poles and in bags (monthly mean values are given).

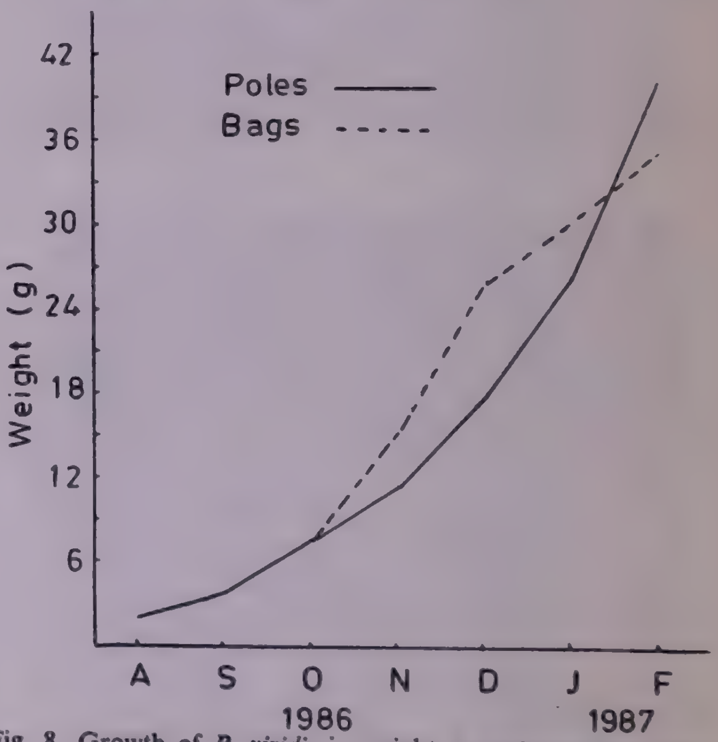

Fig. 8. Growth of *P. viridis* in weight on poles and in bags (monthly mean values are given).

Growth of *P. viridis*, was observed to be 45 mm in 5 months at Kakinada (Narasimham, 1980. *Bull. Cent. Mar. Fish. Res. Inst.*, **29**: 10–17) and 54 to 65 mm in 6 months at Calicut (Kuriakose, 1980. *Bull. Cent. Mar. Fish. Res. Inst.*, **29**: 33-38), when the mussel was grown on ropes in the sea. Earlier at Madras, an average growth of 12.8 to 13.0 mm per month was recorded for the same species in the rope culture at Kovalam Bay (Rangarajan and Narasimham, 1980. *Bull. Cent. Mar. Fish. Res. Inst.*, **29**: 39-41). Though grown in saltwater lagoon like Muttukadu backwaters, growth of *P. viridis* was found to be comparable with that of the mussel at Kakinada and Calicut.

The present experiments are first of its kind indicating the feasibility of culturing the green mussel in saltwater lagoon, by adapting pole and bag culture methods. The mariculture farm at Muttukadu appears to be suitable for green mussel culture.

OBSERVATIONS ON THE FISHERY OF BANANA PRAWN ALONG THE NORTH KANARA COAST WITH NOTES ON ITS SCHOOLING BEHAVIOUR AND MIGRATION*

Introduction

Penaeus (Fenneropenaeus) merguiensis commonly known as banana prawn is one of the commercially important penaeid prawns occurring in Indian waters. This species inhabits the coastal waters upto a depth of about 55 metres. It is relatively more abundant in the shallower areas where the sea bottom is muddy and sandy. *P. merguiensis* occurs throughout the Indo-Pacific in tropical and sub-tropical waters supporting commercial fisheries along the coasts of Malaysia, Thailand, Indonesia, Australia, India and Pakistan. On the west coast of India this species is caught in appreciable quantities from North Kanara, Goa and Ratnagiri coasts. It forms 1.4% of the total prawn landings by shrimp trawlers at Karwar. A seasonal fishery for this species from June to August has been reported from Goa. Fishermen of North Kanara coast operate indigenous gears such as gill nets and shore seines in coastal waters throughout the year at different depths, depending on weather conditions. During 1981, the author noticed occurrence of banana prawns in good quantities in the bottom-set gill nets operated in the inshore waters off Sankrubag landing centre. As this species is a large sized one and in great demand by the fishing industry, a detailed observation of this fishery was undertaken during 1981–'84 along the North Kanara coast and the results are presented in this communication.

Fishery

The bottom-set gill nets are employed for catching prawns along this coast during the monsoon period June to August as in other regions of the west coast. The nets are operated from dug-out canoes (6.0–10.3 m in length), each manned by two persons and the period of each fishing trip extends from about 0530 to 1430 hrs. Usually the prawn grounds covered by this fishery extend upto about 2 km from the shore where depth ranges from 6 to 9 m.

The fishery season generally commences with the onset of monsoon and extends for about three months in June, July and August. Peak of the fishery varies from year to year within this period.

Catch and effort: The centre-wise data on total catch, effort and CPUE for the different centres of observation are given in Table 1. At Chendia, *P. merguiensis* occured in the gill net catches during 1981, '82 and '84. The average daily catch per unit effort (CPUE) was worked out to 1.72 kg for these three years. The maximum catch and CPUE were observed during 1984 and 1982 respectively (Table 1). Continuous observations were made at Sankrubag throughout 1981–'84 and the maximum catch and CPUE were recorded during June–July 1982. The average CPUE was 2.85 kg for this centre. Gill nets were not operated at Karwar during 1981 season due to scarcity of prawns but the fishery existed during 1982–'84. Maximum catch of the banana prawn was noticed during July–August, '82, but the CPUE was at its peak during 1983. The average CPUE for the period 1982–'84 was 5.55 kg. Majali recorded the lowest catch and CPUE, the average CPUE for 1983–'84 period being 0.17 kg. The fishery at Ambekodar could be observed during 1984 only. The maximum catch (12,776 kg) with CPUE of 11.83 kg was observed during July at this centre. Taking into consideration the entire fishery of this coast, maximum landing of *P. merguiensis* was recorded at Ambekodar

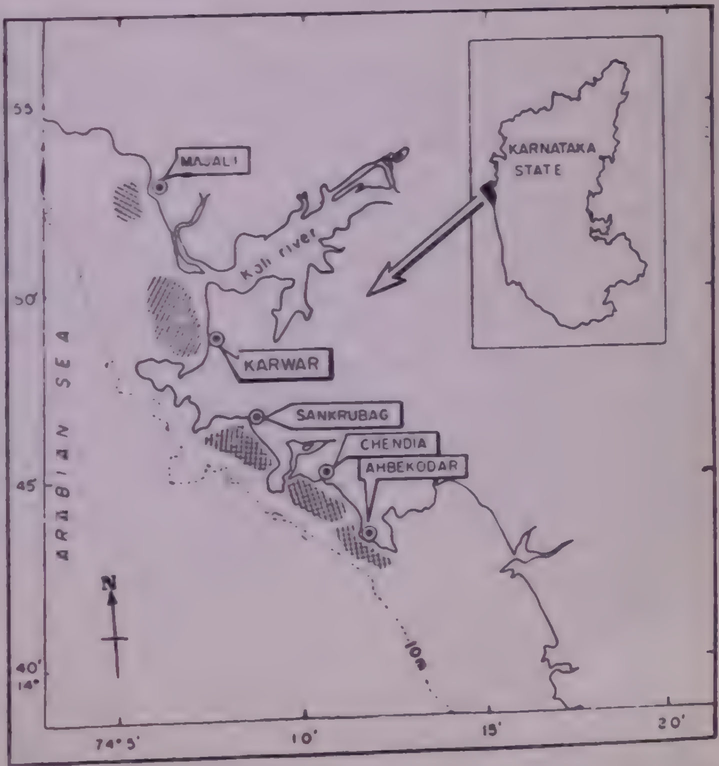

Fig. 1. Map showing the observation centres and the prawn fishing grounds (shaded).

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*Prepared by G. Nandakumar, CMFRI, Cochin.

Table 1. *Centrewise details of catch, effort and CPUE of* Penaeus merguiensis *in the gill net fishery from* 1981 *to* '84.

		Season	Estimated No. of units operated	Catch (kg)	CPUE (kg)
1981	Chendia	Jul.	225	326	1.45
	Sankrubag	Jun.–Jul.	287	580	2.02
1982	Chendia	Jun.–Jul.	50	1,250	25.00
	Sankrubag	Jun.–Jul.	80	2,800	35.00
	Karwar	Jul.–Aug.	1,128	6,387	5.66
1983	Sankrubag	Aug.	550	2,339	4.25
	Karwar	Jul.–Aug.	374	2,930	7.83
	Majali	Jul.–Aug.	2,250	390	0.17
1984	Ambekodar	Jul.	1,080	12,776	11.83
	Chendia	Jul.–Aug.	1,430	1,363	0.93
	Sankrubag	Jul.–Aug.	1,263	485	0.38
	Karwar	Jul.–Aug.	440	1,451	3.30
	Majali	Jul.–Aug.	534	94	0.18

during 1984 while the best CPUE was observed at Sankrubag during June–July, '82. The data also indicated that the prawn production was not consistent at any particular centre (Table 1).

Structure of population: Centrewise details on size range and dominant modal values of males and females of *P. merguiensis* are shown in Fig. 2. The total length of this species varied between 111 and 165 mm for males and 106 and 215 mm for females. The size frequency was generally unimodal or bimodal in nature. The bulk of the fishery was supported by the size groups between 130 and 170 mm. Studies on sex ratio in the prawn catches showed the preponderance of females over males in all the centres during 1981–'84 with an exception at Chendia during 1981–'82 when males outnumbered the females. Most of the females observed in the catches did not have mature ovaries.

Discussion

The present study on the seasonal fishery of *P. merguiensis* along the inshore waters of Karnataka coast during the monsoon period (June–August) reveals some kind of sporadicity of occurrence and schooling behaviour of the banana prawn. It has been established by large-scale tagging experiments that this species is capable of undertaking long range migrations moving even upto 150 km off-shore.

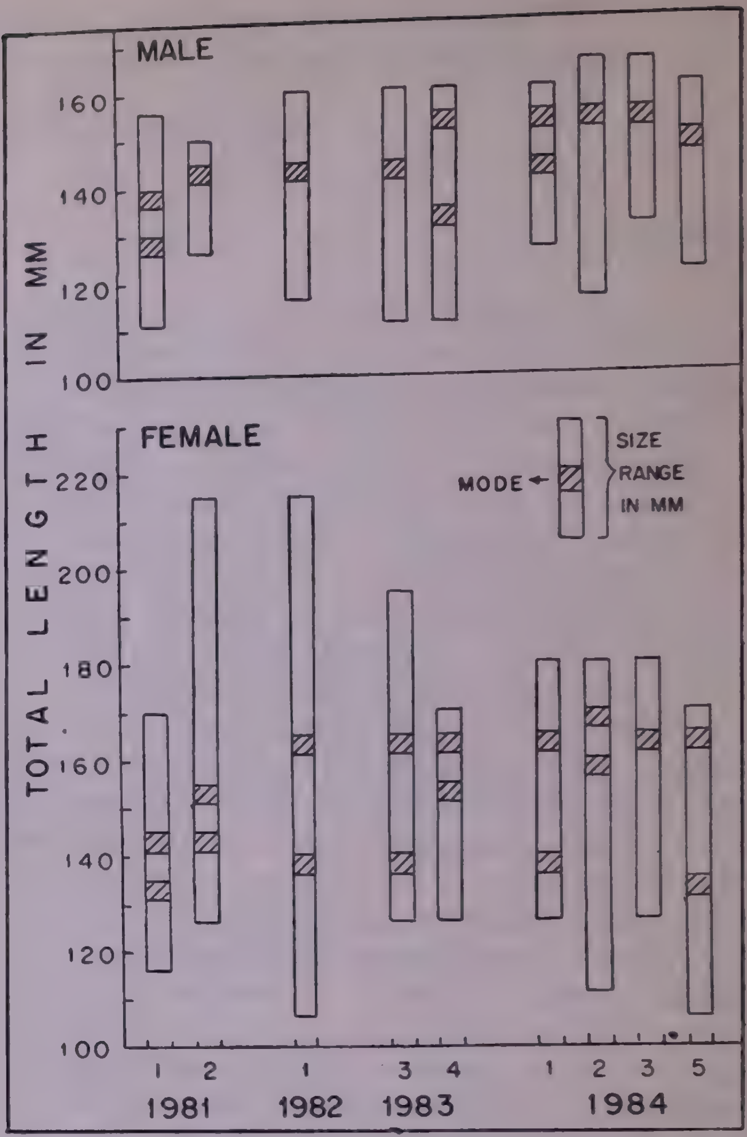

Fig. 2. Size distribution of *Penaeus merguiensis* in the gill net fishery along the North Kanara coast.

1 - Chendia, 2 - Sankrubag, 3 - Karwar, 4 - Majali, 5 - Ambekodar.

In order to ascertain the possible migratory pattern of *P. merguiensis* along the North Kanara coast an attempt was made to closely follow the spurt in the landings at the different centres between Ambekodar and Majali (Fig. 1) during the season of 1984. It was observed that *P. merguiensis* fishery started around Ambekodar, Chendia and Sankrubag during the first week of July, '84 and the maximum catch was recorded at Ambekodar between 6th and 10th July (12 kg of prawn per unit per day). The prawn catch at Chendia and Sankrubag during the same period was 1–2 kg per unit per day except on one occasion when one boat landed a record catch of 100 kg of banana prawns on

10-7-1984. During the third week of July, a few numbers of prawns alone were caught by gill nets in these centres. The fishery was totally absent at Karwar and Majali until 26-7-1984. Suddenly *P. merguiensis* started appearing in Karwar Bay from 27-7-1984 and the peak fishery was observed between 10th and 15th August, 1984. The fishery was absent at Majali during this period. From the above pattern of occurrence of the fishery at different centres it would appear that *P. merguiensis* might have migrated in shoals from south to north along the coast.

Juveniles of *P. merguiensis* show migrations from backwaters to the coastal waters in Karwar region during January–May. It is possible that juveniles migrating from the backwaters during this period remain in the coastal waters until they attain the adolescent stage and then move out to deeper waters.

Shoaling behaviour and migration of the related species *P. indicus* have been reported earlier, along the southwest and southeast coasts based on the studies on commercial catches . Mark recovery experiments (tagging) have now almost established distant migration of the species along these coasts. Although there is no evidence as to the migratory habits of the banana prawn from the Indian waters, the present observations suggest the possibility of shoaling behaviour and migration of the species along the Karnataka coast. Large scale tagging experiments are necessary to establish this.

ON THE OCCURRENCE OF *MESOPODOPSIS ORIENTALIS* TATTERSALL, A MYSID OFF MAHARASHTRA COAST, WITH A NOTE ON ITS FISHERY*

Mysids or 'Oppossum shrimps' as they are popularly called have not been reported to have any fishery value in Maharashtra State. But at Satpati, an important fishing village of Maharashtra a fishery for a species *(Mesopodopsis orientalis)* was noticed to be in existence. It is locally known as 'Kolim' and the net used for its capture as 'Kolim bokshi' The details of the catch during different years are presented below:

Year	Month	Unit	Gear	Catch (kg)	C.P.U. (kg)
1984	Apr.–May	1,360	Kolim bokshi	14,000	10.3
1985	,, ,,	1,450	,,	14,500	10.0
1986	,, ,,	1,500	,,	15,005	10.1

Craft and gear : Dugout canoes locally called *Tony* are engaged for fishing with a crew of two fishermen. The gear used is a stationary bag net locally known as 'Kolim bokshi' operated in the creek at Satpati in about 3–5 m depth. The length of the net is approximately 6–7 m and the mouth is about 2.5 to 3 m. The net is made out of fine meshed nylon cloth with a mesh size of 0.1 mm. The entire cost of the net ranges from Rs. 250–300. The net is tied to the stakes fixed in the creek and is generally operated during the spring tide or *Udhan* period.

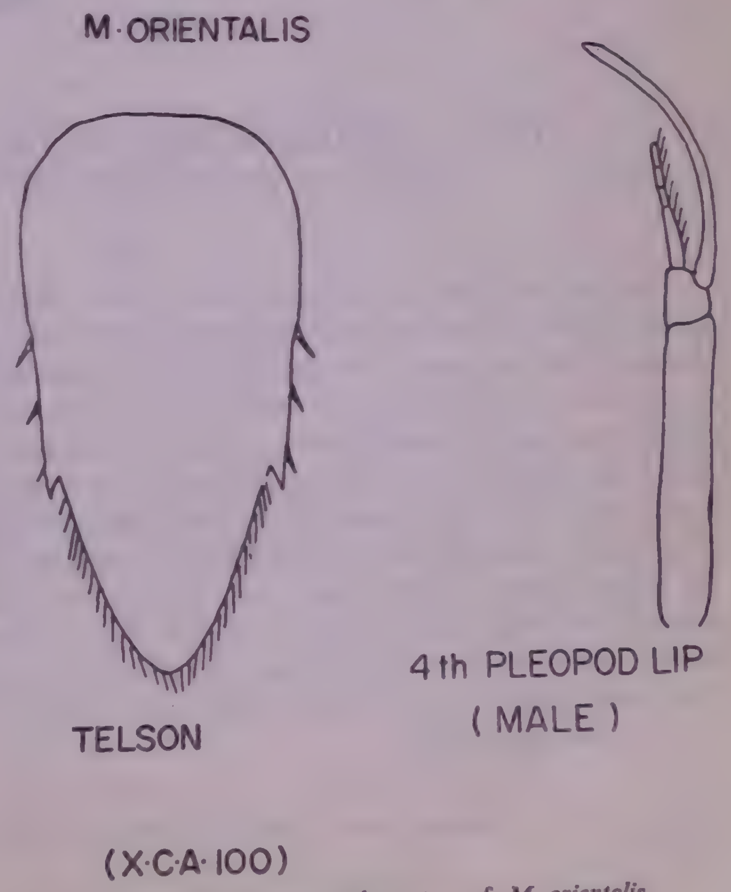

Fig. 1. Chief identification characters of *M. orientalis*.

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*Prepared by M. Aravindakshan, J. P. Karbhari, C. J. Josekutty and J. R. Dias, Bombay Research Centre of CMFRI, Bombay.

The mysid *M. orientalis* comprised 90% of the landings. The other items were fish larvae and larvae of decapod crustaceans.

The chief characters that help in the identification of the species *M. orientalis* are the structure and the shape of telson and the fourth pleopod of males. The lateral spines on telson stated to be four for this species (Pillai, 1965, *Proc. Symp. Crustacea,* MBAI, Part V: 1680-1727) was found to vary from 3–5 (Fig. 1). But majority had only four spines on each side of the telson. No change in the number and nature of the spines on the third exopod segment of the fourth pleopod was noticed.

Remarks: The fishery for *M. orientalis* (Fig. 2) is seasonal. It starts from April and closes just after the first rain in June. The reason for closure is the lack of drying facility for the mysids. The catch is salted and sun-dried. It can fetch a price of Rs. 7–8/kg. It is highly relished by the local people. The size range of the specimens is very small varying from 5–7 mm and the sex ratio was observed to be 1:2 with females in domination. *M. orientalis* is abundantly available during April and May and so the fishermen who cannot go onboard the mechanised country craft/trawlers are engaged in this fishery.

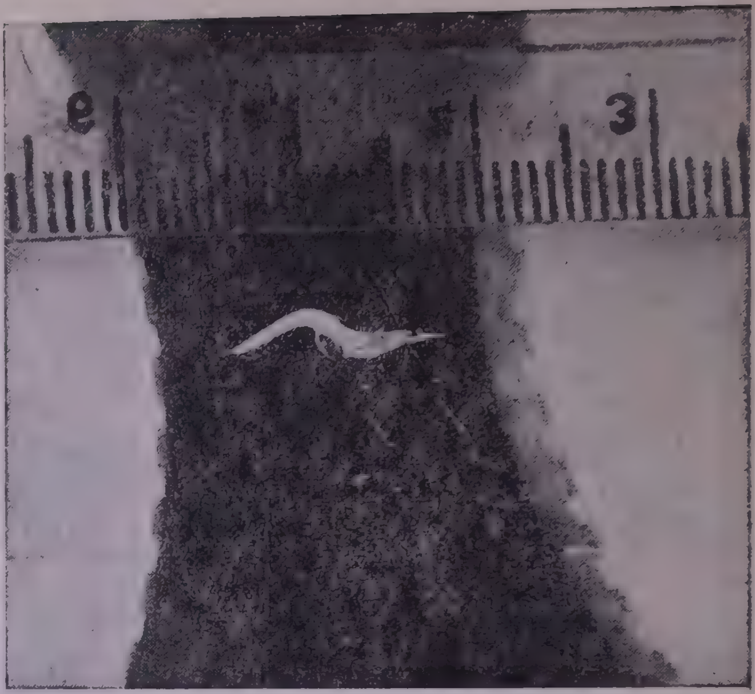

Fig. 2. *Mesopodopsis orientalis*

ON A WHALE SHARK *RHINIODON TYPUS* SMITH LANDED AT PUDUMANAIKUPPAM, MADRAS*

On the 6th March, 1987, a female whale shark measuring 506 cm was landed at 1400 hrs at Pudumanaikuppam landing centre, Madras District, Tamilnadu State. It was reported that the whale shark along with other fishes namely *Scomberomorus* spp. and *Euthynnus affinis* got entangled in a gill net operated by a mechanised boat about 30 km north from the shore at about 70 m depth. The gill net was completely damaged by the whale shark. The boat crew tied nylon rope around the body and brought it to the shore. The whale shark weighed approximately 1,250 kg. As there was no buyer, the whale shark was towed to the sea and discarded.

The following measurements (in cm) have been recorded:

1.	Total length	506
2.	Standard length	389
3.	Width of mouth from angle to angle	74
4.	Snout to first dorsal	217
5.	Snout to second dorsal	301
6.	Snout to first gill	82
7.	Length of caudal fin	117
8.	Snout to pectoral	99
9.	Vertical height of first dorsal fin	44
10.	Vertical height of second dorsal fin	19

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*Reported by S. Subramani, Madras Research Centre of CMFRI, Madras.

ON THE CAPTURE OF A GIANT SIZED 'INDIAN THREADFIN' *POLYNEMUS INDICUS* SHAW AT SATPATI, MAHARASHTRA COAST*

A female specimen of *Polynemus indicus* Shaw locally called 'dara' measuring 170 cm in total length and weighing 50.08 kg was landed at Satpati (about 80 km north of Bombay) on 29th January, 1987. It was caught along with other fishes by a 22-footer mechanised 'bagnetter' in 28 m depth off Murba-Satpati coast. The fish was auctioned locally for a record price of Rs. 855/-.

Day *(Fauna of British India - Fishes*, **2**, *London*, 1889) had recorded a maximum length of 126.6 cm for *Polynemus indicus* with the weight of 9 kg. Mohamed *(Indian J. Fish.*, **2**: 164-179, 1955) had observed 142.3 cm in length with the weight of about 27 kg for this species. According to Fisher & Bianchi *(FAO Species Identification Sheets, Western Indian Ocean, Area* 51 *Vol.* **3**, 1984) the fish attains a maximum length of 142 cm. The present record of the fish is the highest both in length and weight from Indian waters. The important morphometric characters of the present fish (in cm) are presented below.

1.	Total length	...	170
2.	Standard length	...	134
3.	Head length	...	39.4
4.	Girth of body	...	95.4
	Vertical height of		
5.	First dorsal fin	...	26.2
6.	Second dorsal fin	...	27.9
7.	Anal fin	...	20.2
8.	Length of caudal fin from caudal pit along the upper margin	...	37.3
9.	Length of the upper filamentous ray of pectoral fin	...	50.1
10.	Diameter of eye	...	1.6
11.	Distance between eye and nostril	...	3.8
12.	Distance between eye and snout	...	9.5
13.	Length of swim bladder	...	48.5
14.	Weight of swim bladder (g)	...	80
15.	Weight of ovary (kg)	...	1.5

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*Reported by J. P. Karbhari, J. R. Dias and M. Aravindakshan, Bombay Research Centre of CMFRI, Bombay.

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Abbreviation – *Mar. Fish. Infor. Serv., T & E Ser.,* No. **82**: 1988

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2. Monsoon prawn fishery by 'matabala' along the Mangalore coast—a critical study
3. Preliminary observations on the efficiency of some microalgal foods on the growth of green mussel larvae

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Front cover photo:

Perches of species *Pristipomoides types* caught by hooks and line from the Kalava grounds off Cochin being landed at Cochin Fisheries Harbour.

Back cover photo:

Trawl catches being packed for transporting to local and distant markets — a common scene at Cochin Fisheries Harbour.

MARINE FISH CALENDAR

IV. COCHIN*

M. Abdul Nizar, K. Balachandran, V. N. Bande, K. C. George, N. Gopinatha Menon,
Grace Mathew, A. A. Jayaprakash, Kesavan Elayath, V. A. Narayanan Kutty, J. Narayanaswami,
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Central Marine Fisheries Research Institute, Cochin

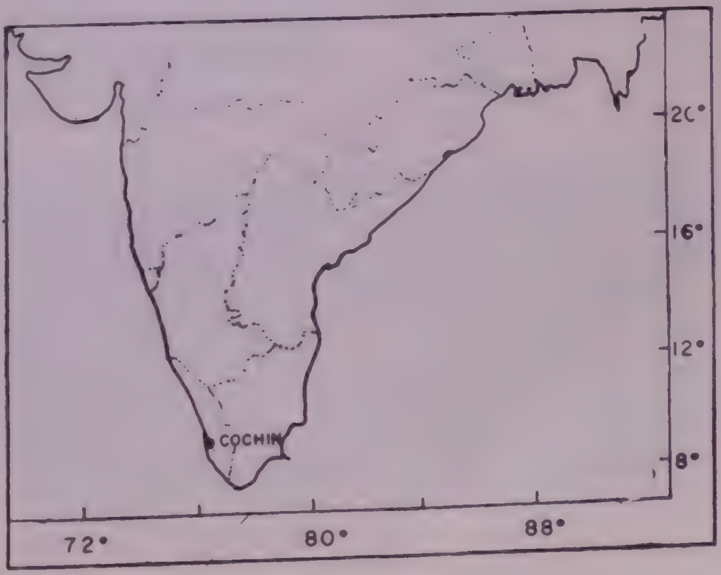
Introduction

Cochin Fisheries Harbour, one of the major fisheries harbours of Kerala, accounted for an average annual landing of 25,700 t (1981–'85) of fish caught from the coastal waters by all gears operated by both non-mechanised and mechanised vessels which formed about 8% of the total fish landings of Kerala. The pelagic fish resources formed almost 64% and demersal fish 36% of the total yield. Prior to the commissioning of this fishery port in 1978, the landings were made mostly at Kannamali, Manassery, Soudhi beach and Fort Cochin. The principal gears then employed were shrimp trawls, boat seines ('thangu vala'), gill nets and hooks and lines. In the late seventies, the purse seines were introduced to the fishing fleet of Cochin Fisheries Harbour, which altogether changed the fishing strategy of this region. During the period 1981–'85 purse seines accounted for almost 52% of the total fish catch of this centre, followed by trawlers (38%) and the rest by drift gill nets, boat seines, hooks and lines *etc.*

Among the pelagic fishes landed, oil sardine ranked first, forming about 44% of the total fish catch of Cochin. The next important component in the pelagic realm was mackerel (11%) followed by tunas (3%), carangids (2.5%) *etc.* The demersal group was dominated by threadfin breams (12%) followed by cat fishes (3%), lizard fishes, flat fishes and sharks and rays.

Fishing activities are restricted upto a maximum depth of 80 m, between Alleppey in the south and Chawghat in the north. The bottom in the region is mostly of grey and black mud deposit upto about 40 m and beyond this depth upto 160 m, the bottom is predominently sandy with lesser percentage of mud and shell fragments. Trawlers generally operate in depth range of 25–50 m and drift gill nets in 25–80 m; whereas purse seine operates beyond 30 m, eventhough very often this gear encircles shoals of fishes in shallow depths (10 – 15 m) also depending on the seasonal availability of shoals, disregarding the restrictions.

Gearwise, purse seines made the bulk of the landings, and the most dominant fishes were oil sardine (74%), mackerel (15%), other sardines (3%), carangids (3%), cat fishes (1.2%), pomfrets (1.1%) *etc.* The peak fishing season for purse seine was postmonsoon (42%) followed by summer (32%), premonsoon (14%) and monsoon (12%). The important fish groups in the trawlers were threadfin breams (33.7%), cat fishes (5.2%), sciaenids (4%), soles (4.6%), anchovies (3%), clupeids (2.3%), lizard fishes (2.9%) *etc.* In addition to different fish groups, penaeid prawns and crabs contributed a substantial percentage (12.5%) in the trawl catches. The fishing season for the gear commences in monsoon period and almost 40% of the landings was during this period. The premonsoon period contributed 30%, summer 20% and the postmonsoon 10%. In the drift gill net, tunas were the most abun-



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*Consolidated by N. Gopinatha Menon and K. Balachandran, CMFRI, Cochin.

dant fish (31%) followed by elasmobranchs (18%), cat fishes (15%), seer fishes (16%) carangids (7%), pomfrets (5%) *etc.* Monsoon months contributed the maximum landings (41%) followed by premonsoon (29%), postmonsoon (18%) and summer (1.2%).

The annual average catch of pelagic groups at Cochin showed that oil sardine ranked first (11,315 t), with 98% caught by purse seine, the peak months of landings being November and December. Mackerel was the next abundant fish forming 2,743 t, with 98% contributed by purse seine and the peak months of landings from September to November. Tunas and carangids formed about 770 t and 644 t respectively with the major landings during April to December. Seer fishes contributed 427 t and major fishing season was from August to December which was followed by whitebait (354 t) in October and November and pomfrets (271 t) in August to November.

Among the demersal resources, threadfin breams formed the bulk of the landings with an annual average catch of 3,118 t. The peak months of their landings were June to October. Cat fishes were the next dominant resource with the annual average catch at 696 t and the maximum harvest from June to February. Lizard fishes and flat fishes formed 430 and 381 t respectively with peak landings from June to September. Sharks and rays together contributed 378 t in almost equal proportions, the major season being April to December for sharks and November to March for rays. Perches were predominantly caught by hooks and line and were highly seasonal in their occurrence (January and February) with an annual average catch of 28 t.

CARANGIDAE

Popular English Name : Trevallies/Scads
Vernacular Name (Malayalam) : 'Para'/'Vatta'
Annual average catch : 245.3 t
Percentage in total catch : 1.0
Fishing methods and their contribution : Purse seine : 66.5%
Drift net : 22.4%
Trawl net : 11.1%

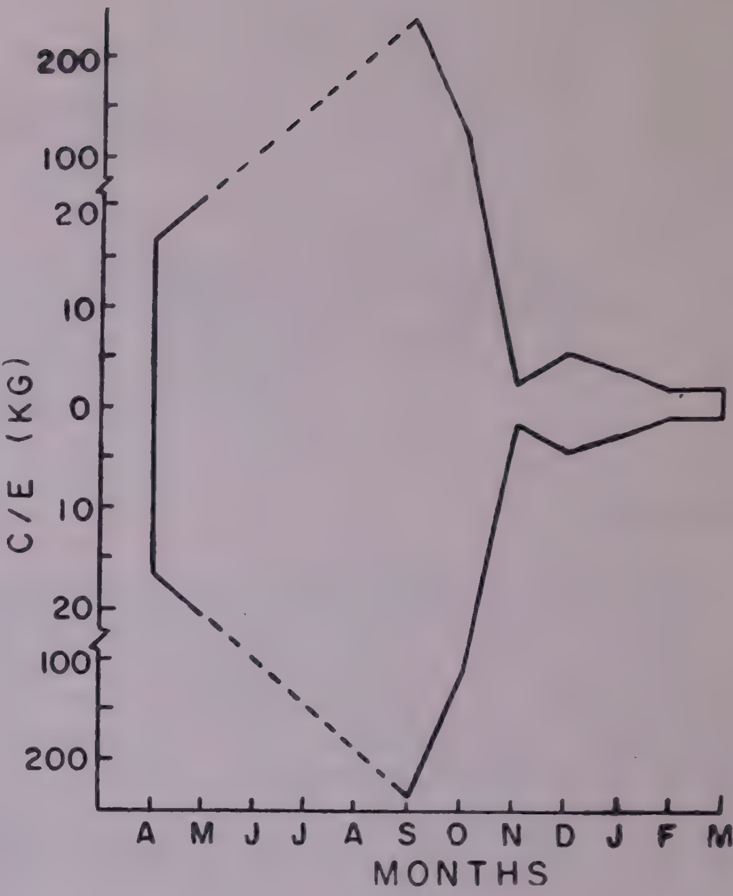

Fig. 1. Seasonal abundance of carangids. (Purse seine catch).

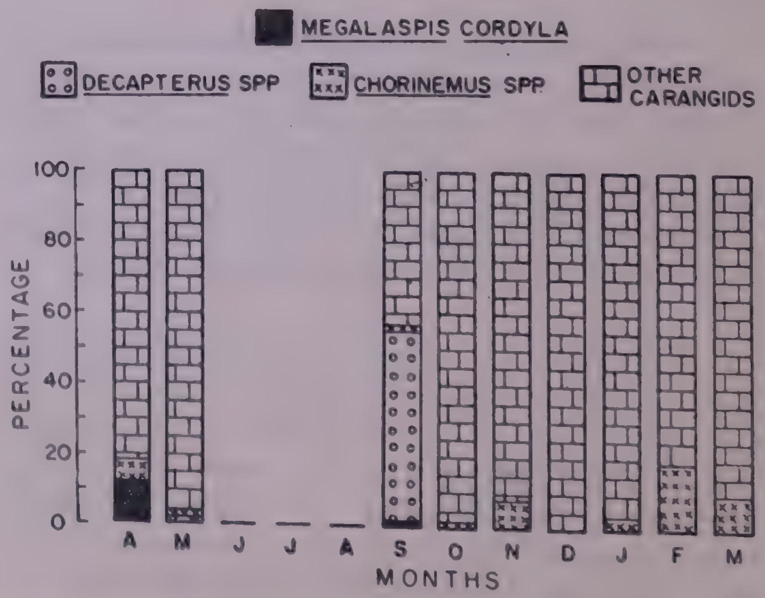

Fig. 2. Monthwise species composition of carangids in the purse seine catch.

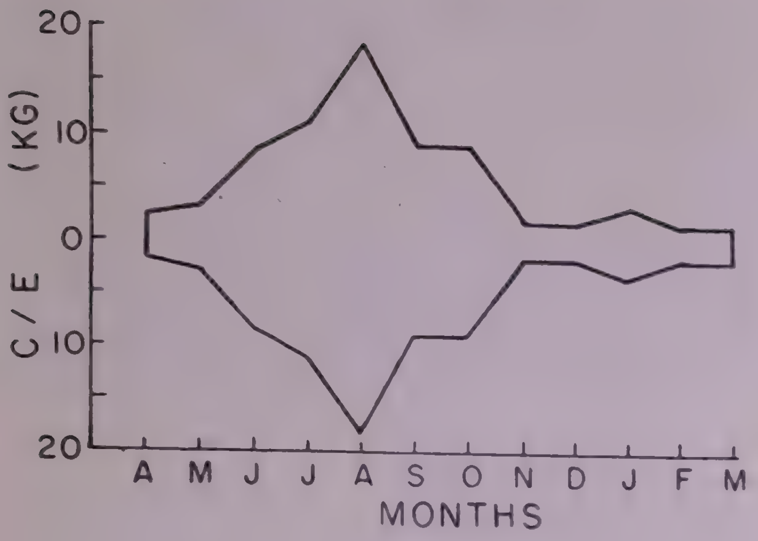

Fig. 3. Seasonal abundance of carangids (Drift net).

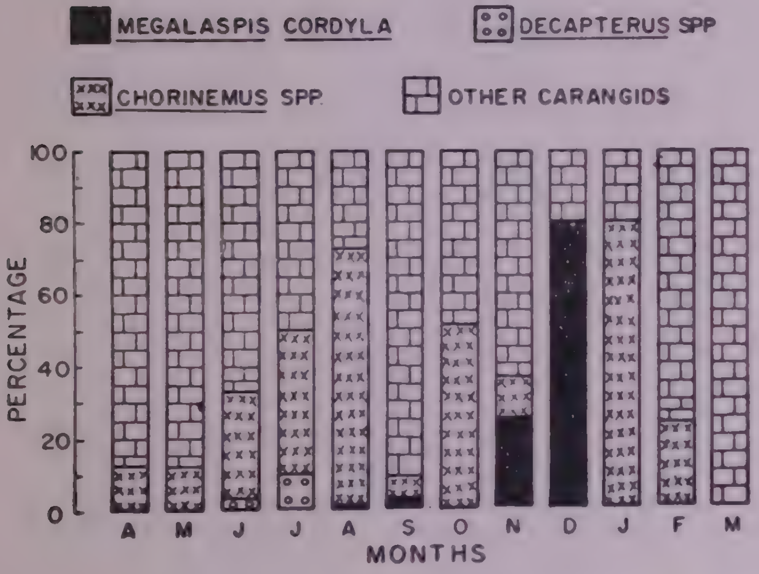

Fig. 4. Monthwise species composition of carangids in the drift net catch.

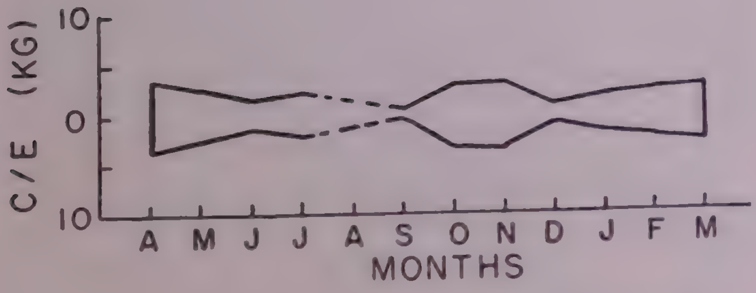

Fig. 5. Seasonal abundance of carangids (Trawl net).

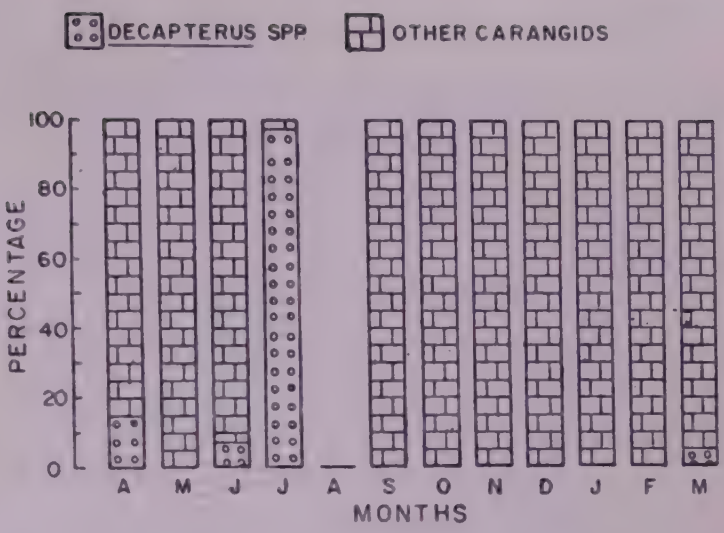

Fig. 6. Monthwise species composition of carangids in the trawl catch.

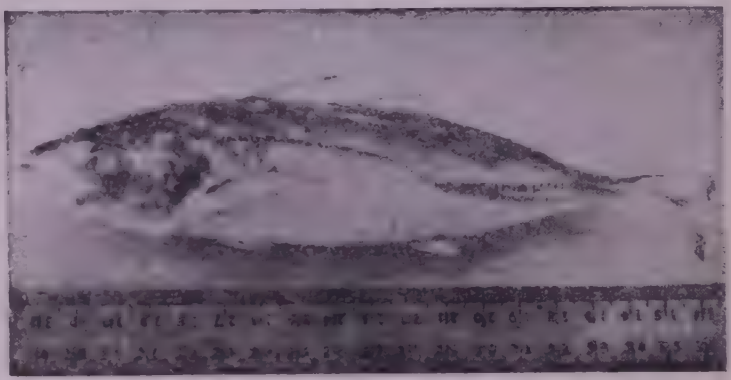

Fig. 7. *Decapterus russelli.*

Scientific Name : *Decapterus russelli*
Vernacular Name : 'Thiriyan'
Gear : Purse seine/Trawl net
Percentage contribution by each gear : —
Peak period of occurrence : Jan.–Feb. and Jul.–Sep.
Depth of occurrence : 20–50 m
Length range in commercial fishery : 70–220 mm
Size at first maturity : 130 mm
Spawning season : May–July

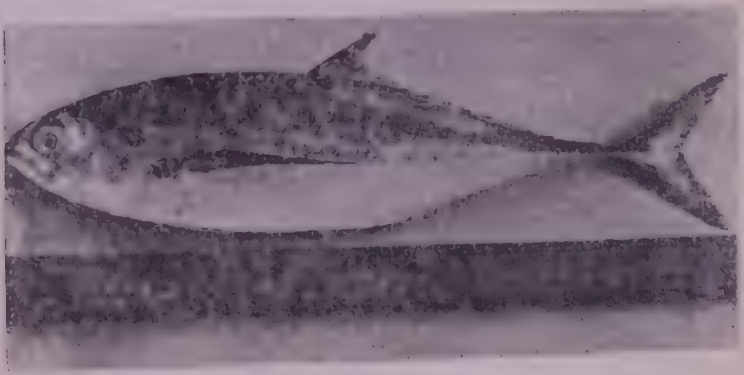

Fig. 8. *Megalaspis cordyla.*

Scientific Name	:	*Megalaspis cordyla*
Vernacular Name	:	'Vangada'
Gear	:	Trawl net/Purse seine
Percentage contribution by each gear	:	—
Peak period of occurrence	:	Nov. – Dec.
Depth of occurrence	:	20 – 80 m
Length range in commercial fishery	:	150 – 390 mm
Size at first maturity	:	270 mm
Spawning season	:	May – July

CLUPEIDAE

Popular English Name	:	Oil sardine
Vernacular Name (Malayalam)	:	'Mathi'/'Chala'
Annual average catch	:	11,314.8 t
Percentage in total catch	:	45.72
Fishing methods and their contribution	:	Purse seine : 97.8% Trawl net : 2.2%

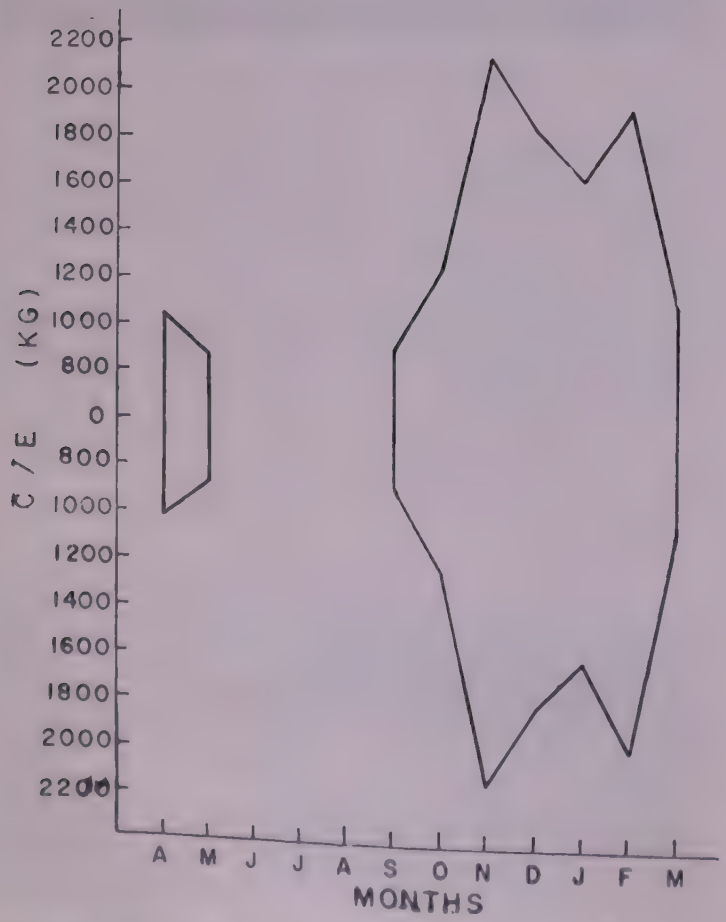

Fig. 9. Seasonal abundance of clupeids (Purse seine catch).

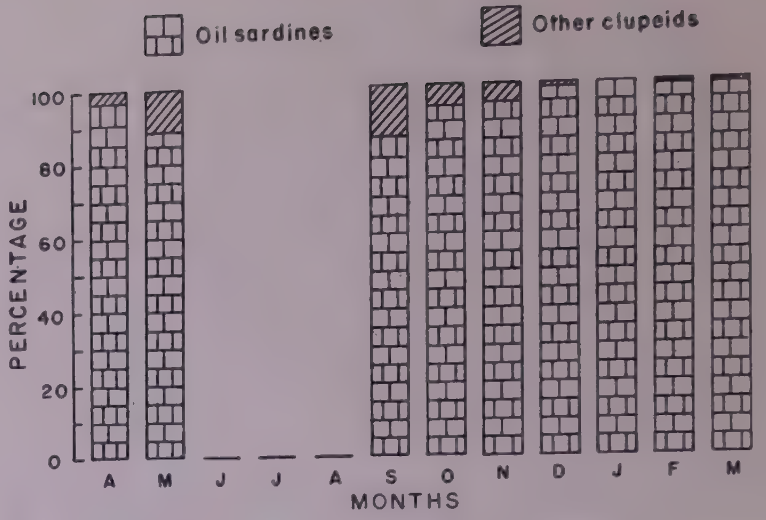

Fig. 10. Monthwise species composition of clupeids in the purse seine catch.

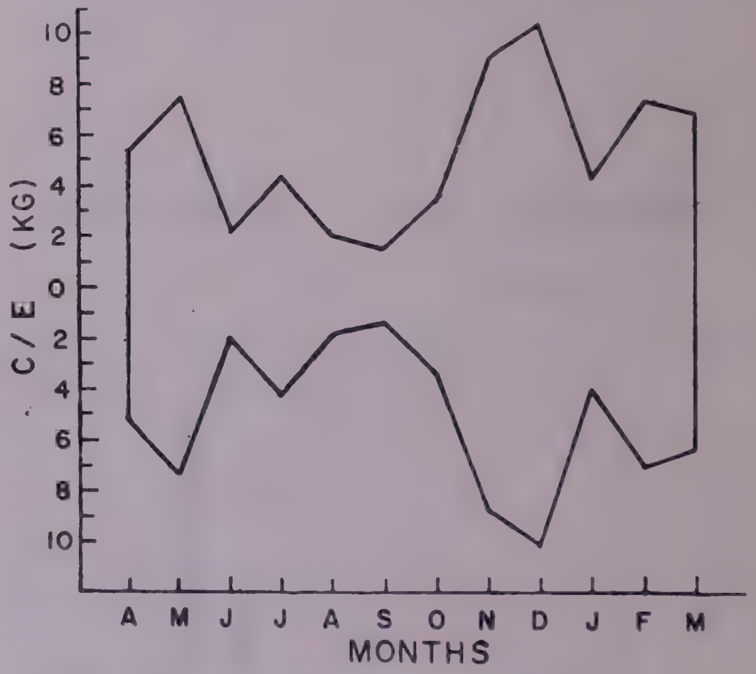

Fig. 11. Seasonal abundance of clupeids (Trawl net).

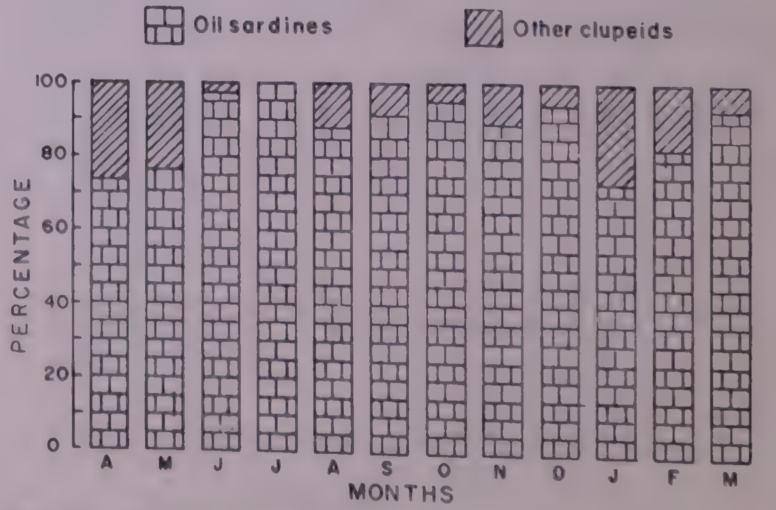

Fig. 12. Monthwise species composition of clupeids in trawl catch.

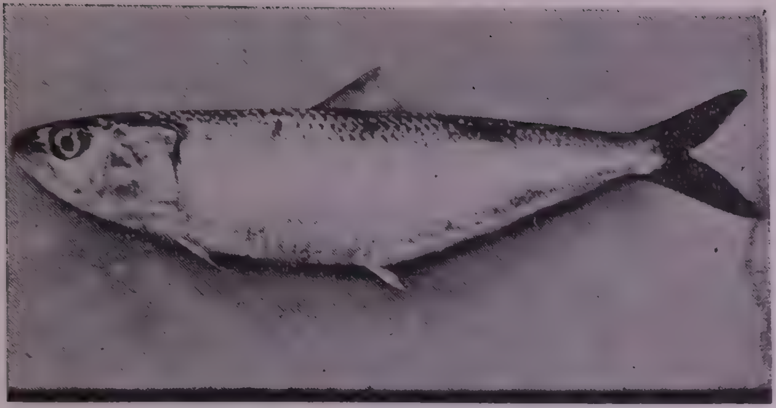

Fig. 13. *Sardinella longiceps.*

Scientific Name : *Sardinella longiceps*
Vernacular Name : 'Nalla mathi'/'Neichala'
Gear : Purse seine/Trawl net
Percentage contribution by each gear : Purse seine : 97.8
Trawl net : 2.2
Peak period of occurrence : Nov. – Dec.
Depth of occurrence : Upto 50 m
Length range in commercial fishery : 145 – 185 mm
Size at first maturity : 150 mm
Spawning season : June – July

CYNOGLOSSIDAE

Popular English Name : Soles
Vernacular Name (Malayalam) : 'Manthal'/'Nangu'
Annual average catch : 375 t
Percentage in total catch : 1.6
Fishing methods and their contribution : Trawl net : 100%

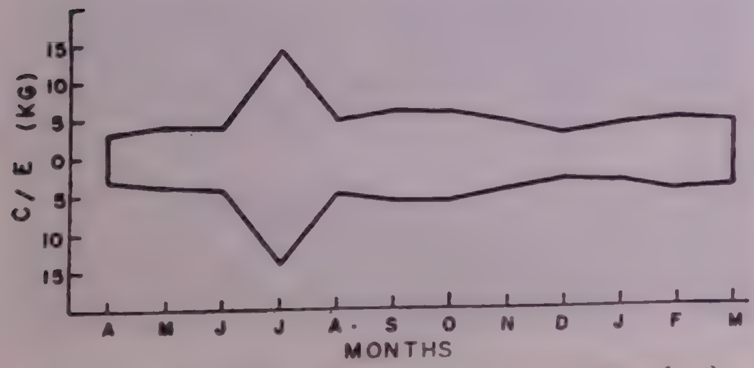

Fig. 14. Seasonal abundance of Cynoglossidae (Trawl net).

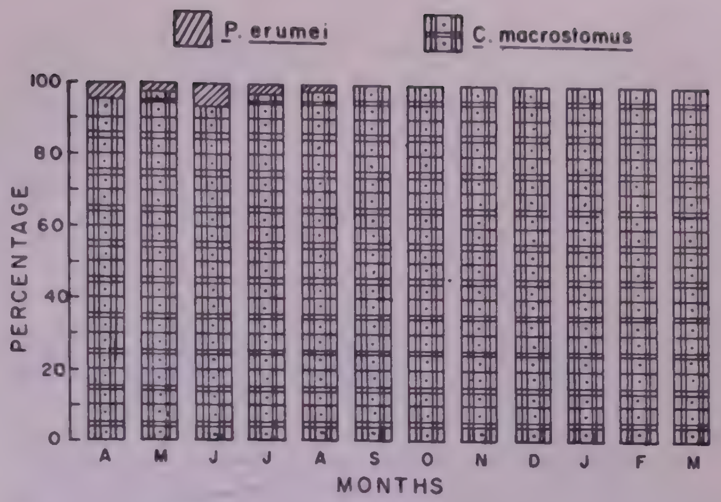

Fig. 15. Monthwise species composition of Cynoglossidae in trawl catch.

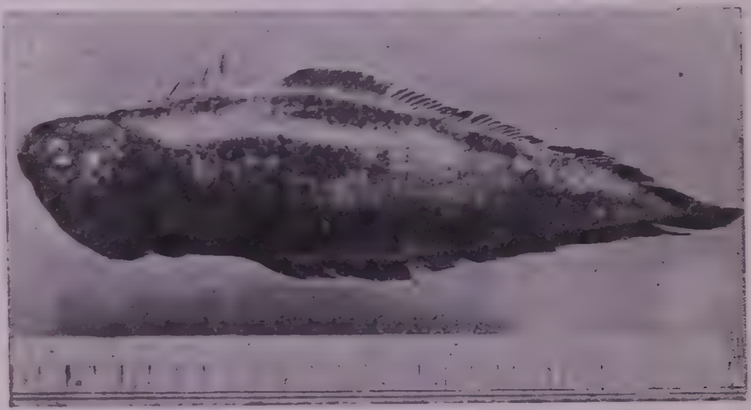

Fig. 16. *Cynoglossus macrostomus.*

Scientific Name : *Cynoglossus macrostomus*
Vernacular Name : 'Manthal'/'Nangu'
Gear : Trawl net
Percentage contribution by the gear : 100
Peak period of occurrence : Jun. - Aug.
Depth of occurrence : Upto 40 m
Length range in commercial fishery : 87 - 150 mm
Size at first maturity : —
Spawning season : —

ELASMOBRANCHS

Popular English Name : Sharks
Vernacular Name (Malayalam) : 'Sravu'
Annual average catch : 163 t
Percentage in total catch : 0.86
Fishing methods and their contribution : Drift net : 76%
Trawl net : 24%

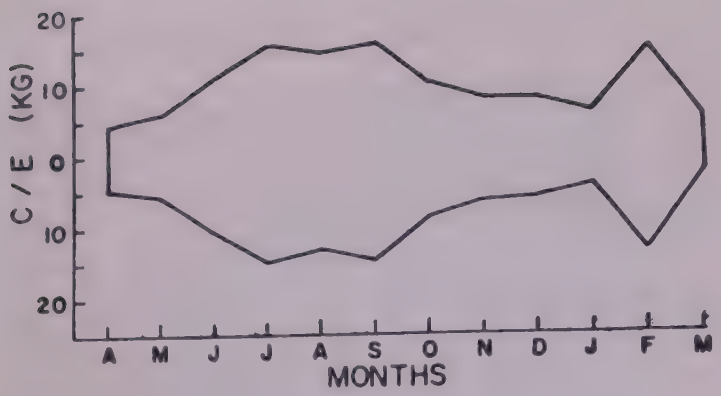

Fig. 17. Seasonal abundance of elasmobranchs (Drift net).

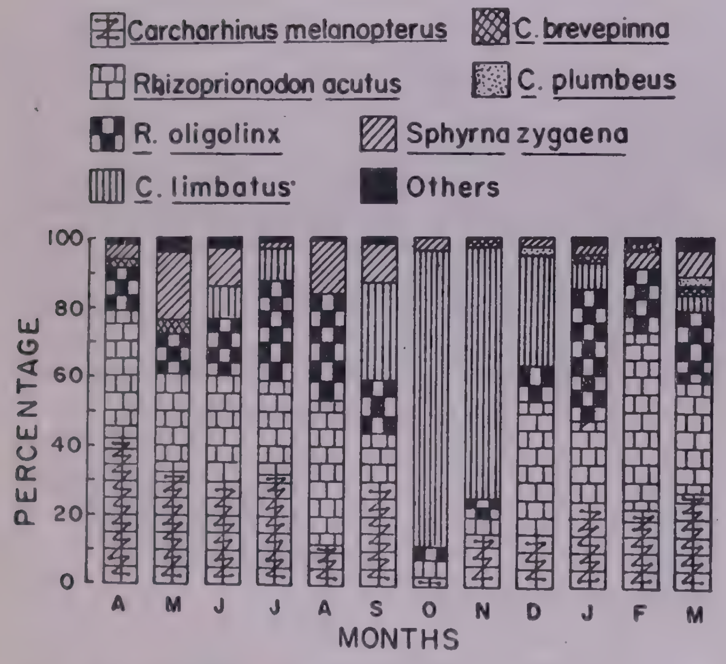

Fig. 18. Monthwise species composition of sharks in drift net catch.

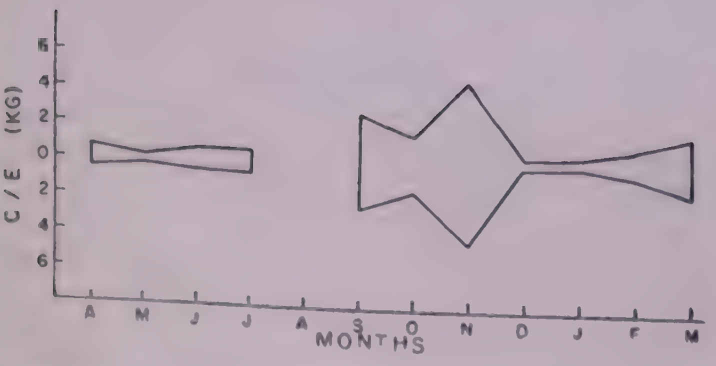

Fig. 19. Seasonal abundance of elasmobranchs (Trawl net).

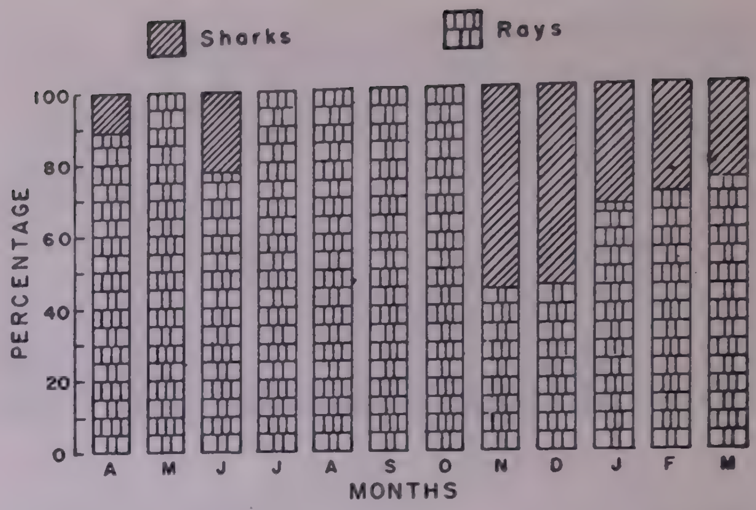

Fig. 20. Monthwise composition of shark and rays in trawl net.

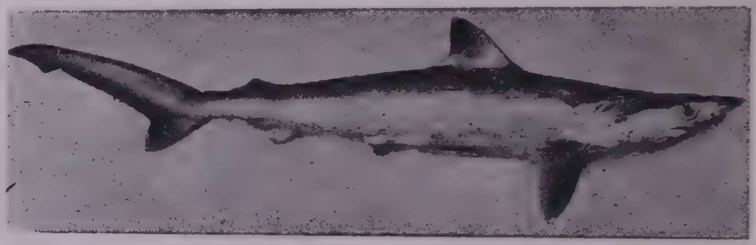

Fig. 21. *Rhizoprionodon acutus.*

Scientific Name : *Rhizoprionodon acutus*
Vernacular Name : 'Sravu'
Gear : Drift net
Percentage contribution by the gear : 100
Peak period of occurrence : Feb. – May
Depth of occurrence : 50 m
Length range in commercial fishery : 485 – 780 mm
Size at first maturity : —
Spawning season : —

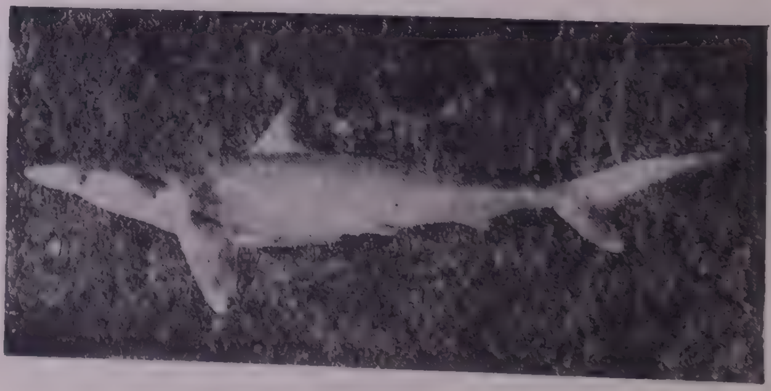

Fig. 22. *Rhizoprionodon oligolinx*

Scientific Name : *Rhizoprionodon oligolinx*
Vernacular Name : 'Sravu'
Gear : Drift net
Percentage contribution by the gear : 100
Peak period of occurrence : Jan. and Jul. - Aug.
Depth of occurrence : 50 m
Length range in commercial fishery : 370 - 800 mm
Size at first maturity : —
Spawning season : —

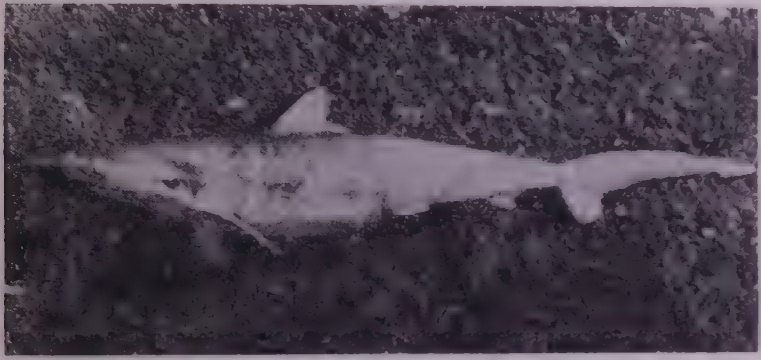

Fig. 23. *Carcharhinus limbatus.*

Scientific Name : *Carcharhinus limbatus*
Vernacular Name : 'Sravu'
Gear : Drift net
Percentage contribution by the gear : 100
Peak period of occurrence : Oct. – Nov.
Depth of occurrence : 50 m
Length range in commercial fishery : 620 – 1,080 mm
Size at first maturity : —
Spawning season : —

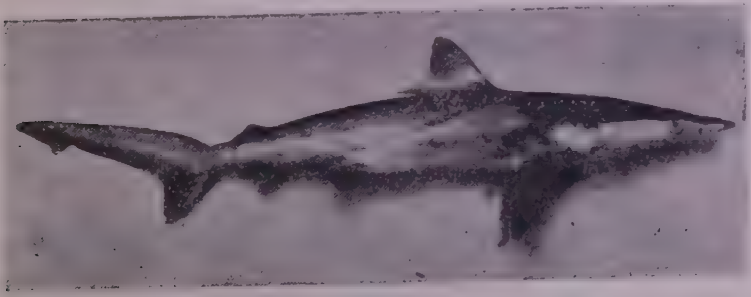

Fig. 24. *Carcharhinus melanopterus.*

Scientific Name : *Carcharhinus melanopterus*
Vernacular Name : 'Sravu'
Gear : Drift net
Percentage contribution by the gear : 100
Peak period of occurrence : Apr. – Jul.
Depth of occurrence : 50 m
Length range in commercial fishery : 530 – 2,120 mm
Size at first maturity : —
Spawning season : —

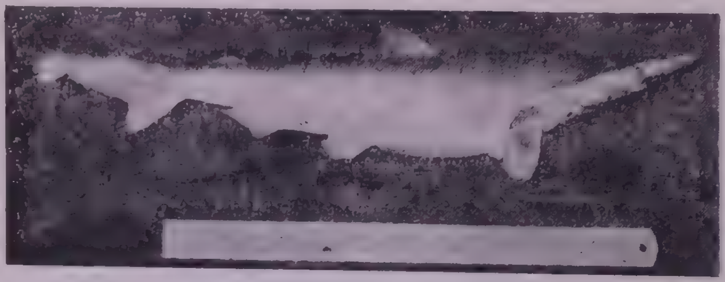

Fig. 25. *Scoliodon laticaudus*

Scientific Name : *Scoliodon laticaudus*
Vernacular Name : 'Sravu'
Gear : Trawl net
Percentage contribution by the gear : 100
Peak period of occurrence : Nov. - Dec.
Depth of occurrence : 40 m
Length range in commercial fishery : 290 - 565 mm
Size at first maturity : —
Spawning season : —

SPHYRNIDAE
HAMMER HEAD SHARK

Popular English Name : Hammer-head shark
Vernacular Name (Malayalam) : 'Komban Sravu'
Annual average catch : 12.3 t
Percentage in total catch : 0.05
Fishing methods and their contribution : Drift net : 100%

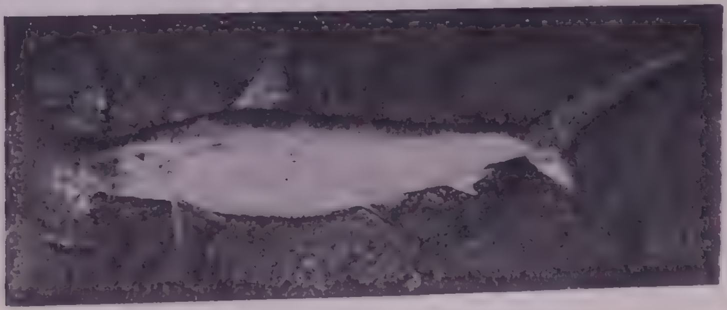

Fig. 26. *Sphyrna zygaena*

Scientific Name	:	*Sphyrna zygaena*
Vernacular Name	:	'Komban Sravu'
Gear	:	Drift net
Percentage contribution by the gear	:	100
Peak period of occurrence	:	Jun. - Sep.
Depth of occurrence	:	50 m
Length range in commercial fishery	:	700 - 1,640 mm
Size at first maturity	:	—
Spawning season	:	—

ENGRAULIDAE

Popular English Name	:	White baits/Anchovies
Vernacular Name (Malayalam)	:	'Kozhuva'/'Netholi'
Annual average catch	:	353.8 t
Percentage in total catch	:	1.4
Fishing methods and their contribution	:	Purse seine : 46.9 % Trawl net : 53.1 %

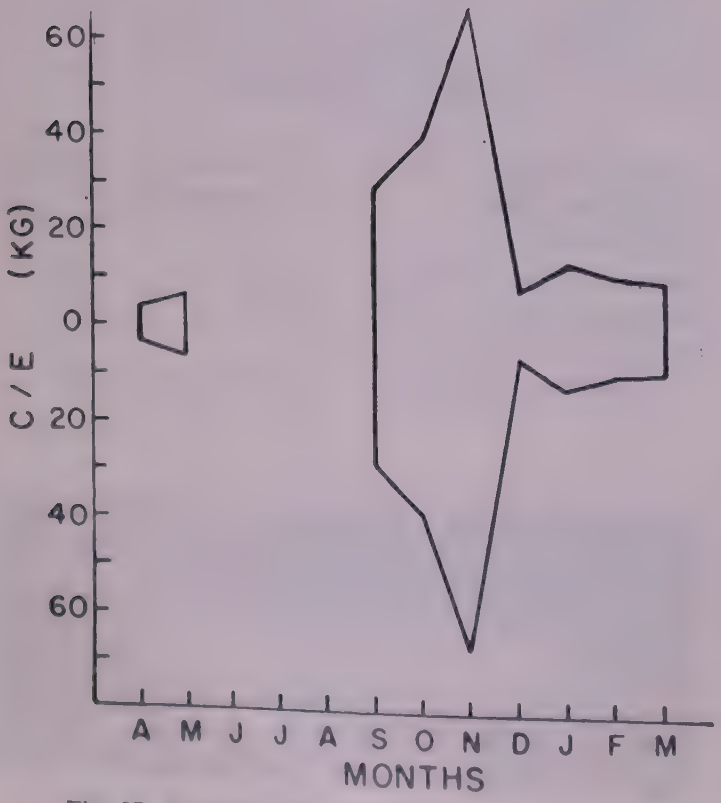

Fig. 27. Seasonal abundance of engraulids (Purse seine).

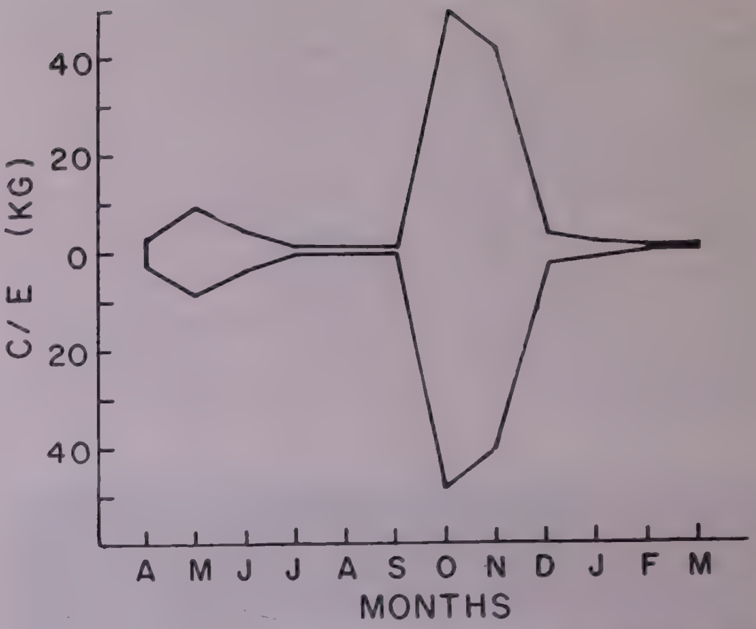

Fig. 28. Seasonal abundance of engraulids (Trawl net).

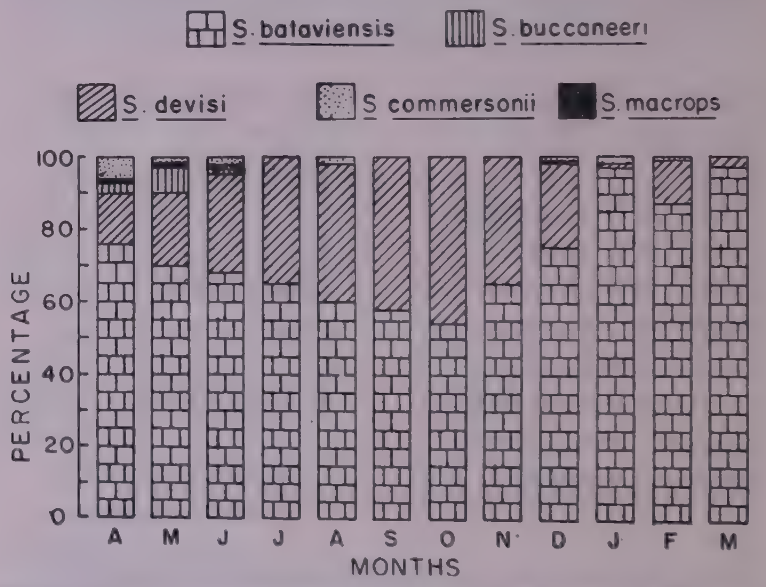

Fig. 29. Monthwise species composition of engraulids in trawl net.

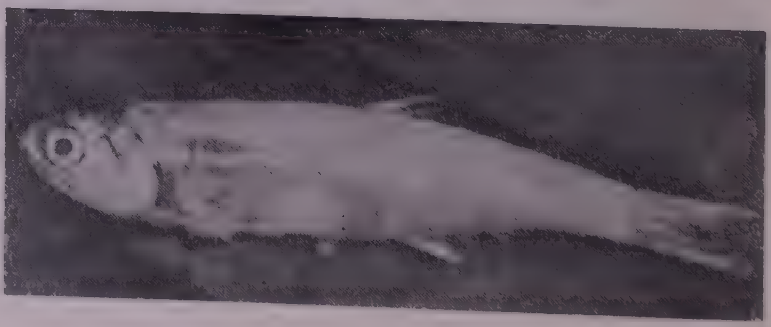

Fig. 30. *Stolephorus bataviensis*.

Scientific Name : *Stolephorus bataviensis*
Vernacular Name : 'Kozhuva'
Gear : Purse seine/Trawl net
Percentage contribution by each gear : Purse seine : 27.6
Trawl net : 72.4
Peak period of occurrence : Jan. – Feb.
Depth of occurrence : Upto 50 m
Length range in commercial fishery : 45 – 105 mm
Size at first maturity : 67 mm (male)
77 mm (female)
Spawning season : Dec. – Mar.

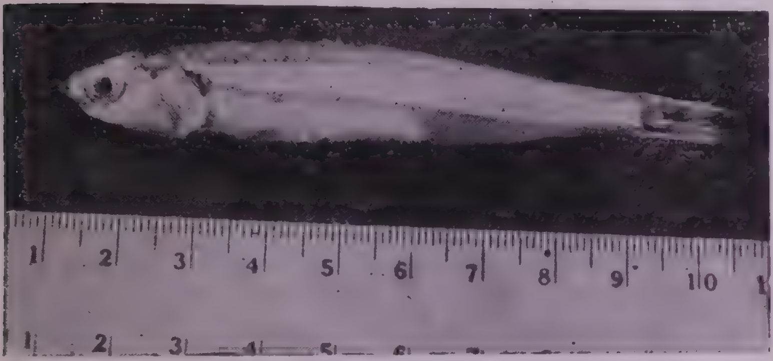
Fig. 31. *Stolephorus devisi.*

Scientific Name : *Stolephorus devisi*
Vernacular Name : 'Kozhuva'/'Netholi'
Gear : Purse seine/Trawl net
Percentage contribution by each gear : Purse seine : 75
Trawl net : 25
Peak period of occurrence : Oct. – Nov.
Depth of occurrence : Upto 50 m
Length range in commercial fishery : 40 – 100 mm
Size at first maturity : 57 mm (male)
61 mm (female)
Spawning season : Dec. – Mar.

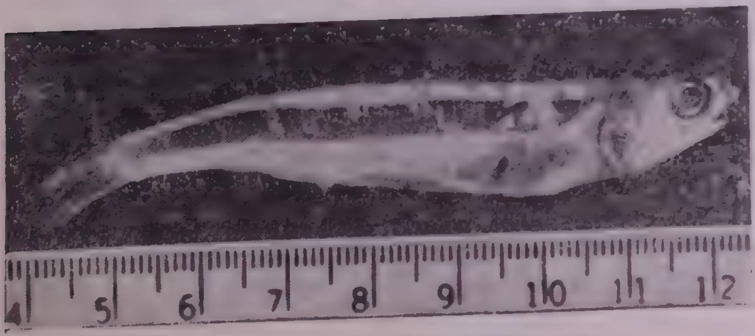
Fig. 32. *Stolephorus buccaneeri*

Scientific Name : *Stolephorus buccaneeri*
Vernacular Name : 'Kozhuva'
Gear : Purse seine/Trawl net
Percentage contribution by each gear : Purse seine : 99.1
Trawl net : 0.9
Peak period of occurrence : Apr. – Jun.
Depth of occurrence : Upto 50 m
Length range in commercial fishery : 50 – 90 mm
Size at first maturity : —
Spawning season : Dec. – Mar.

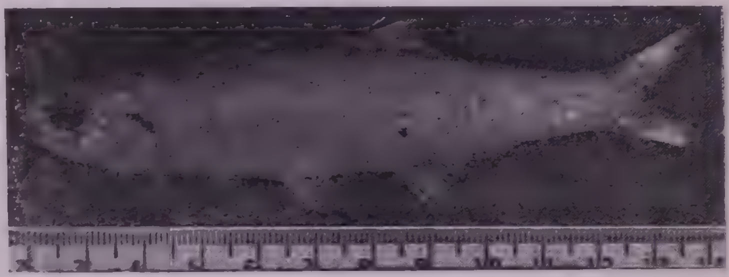
Fig. 33. *Stolephorus commersonii.*

Scientific Name : *Stolephorus commersonii*
Vernacular Name : 'Kozhuva'
Gear : Purse seine/Trawl net
Percentage contribution by each gear : Purse seine : 98.7
Trawl net : 1.3
Peak period of occurrence : Apr. – May
Depth of occurrence : upto 50 m
Length range in commercial fishery : 75 – 125 mm
Size at first maturity : 110 mm
Spawning season : Dec. – Mar.

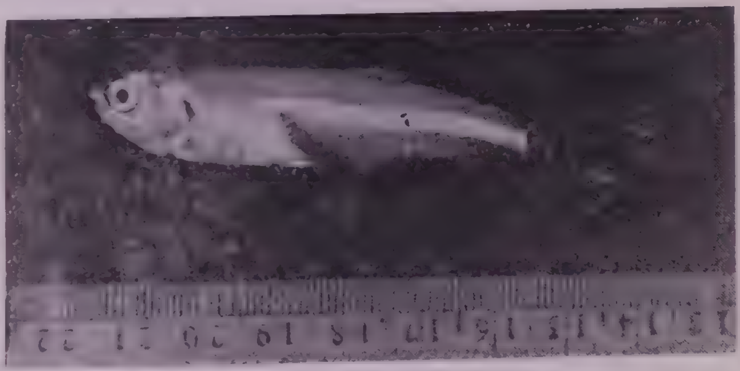
Fig. 34. *Stolephorus macrops.*

Scientific Name : *Stolephorus macrops*
Vernacular Name : 'Kozhuva'
Gear : Purse seine/Trawl net
Percentage contribution by each gear : Purse seine : 99.7
Trawl net : 0.3

Peak period of occurrence : Apr. – Jun.
Depth of occurrence : Upto 50 m
Length range in commercial fishery : 45 – 85 mm
Size at first maturity : 67 mm
Spawning season : Dec. – Mar.

NEMIPTERIDAE

Popular English Name : Threadfin bream
Vernacular Name (Malayalam) : 'Kilimeen'/ 'Puthiapla kora'
Annual average catch : 3,118 t
Percentage in total catch : 37.6
Fishing methods and their contribution : Trawl net : 100%

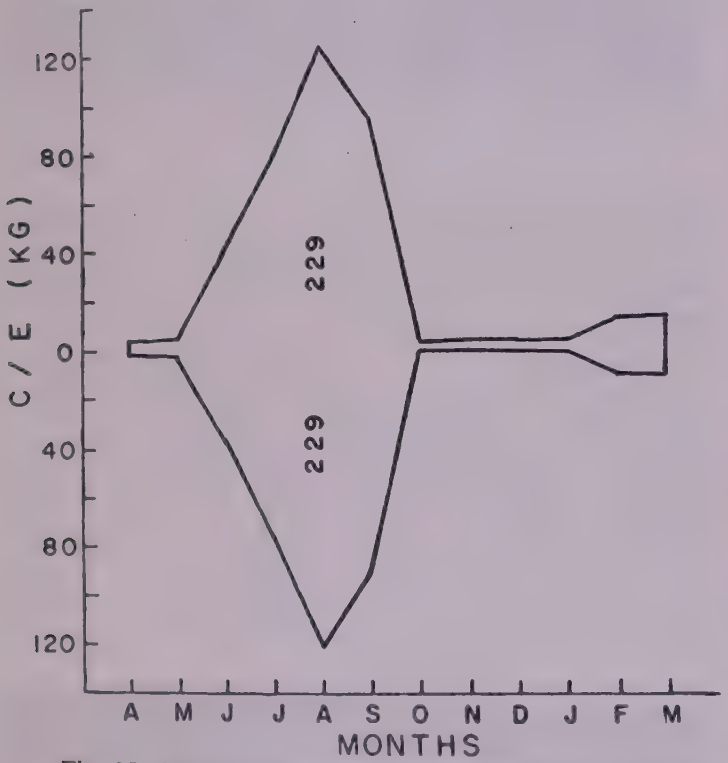

Fig. 35. Seasonal abundance of nemipterids (Trawl net).

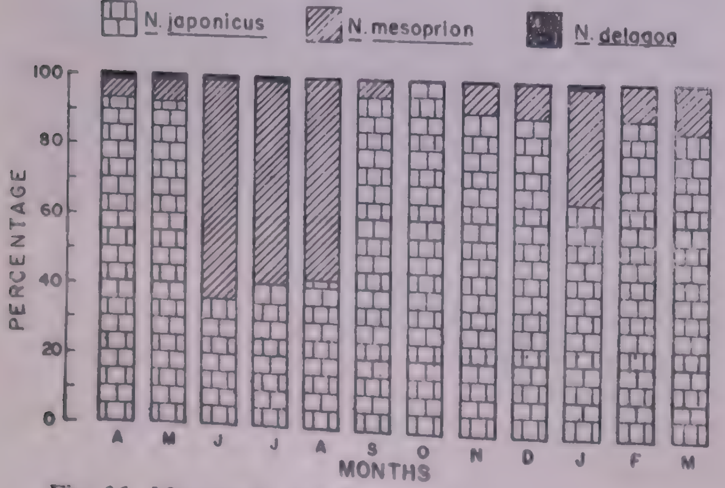

Fig. 36. Monthwise species composition of nemipterids (Trawl net).

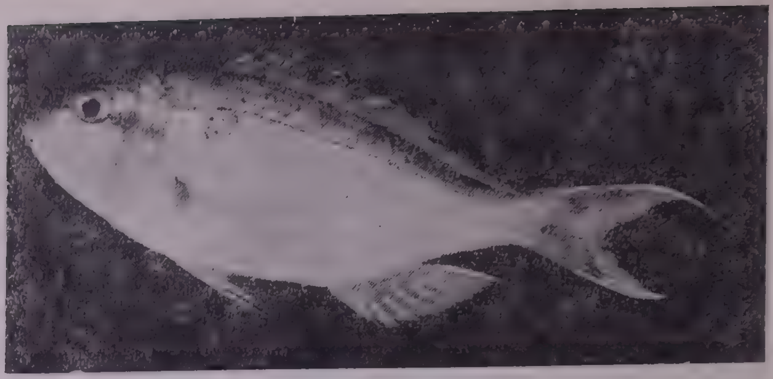

Fig. 37. *Nemipterus japonicus.*

Scientific Name : *Nemipterus japonicus*
Vernacular Name : 'Kilimeen'/ 'Puthiapla kora'
Gear : Trawl net
Percentage contribution by the gear : 100
Peak period of occurrence : Jul. – Sept.
Depth of occurrence : upto 75 m
Length range in commercial fishery : 70 – 300 mm
Size at first maturity : 180 mm
Spawning season : Jul. – Nov.

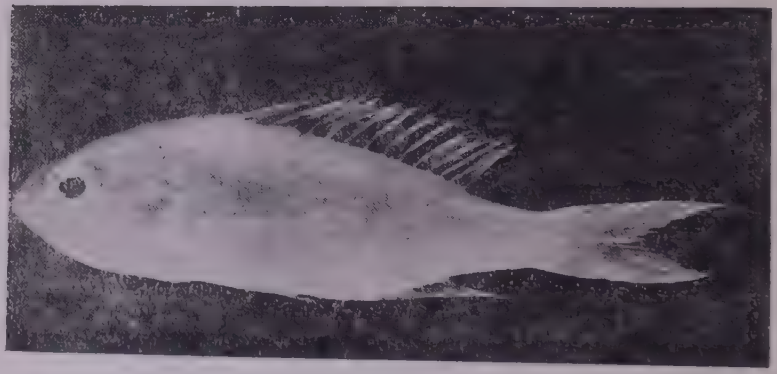

Fig. 38. *Nemipterus mesoprion*

Scientific Name : *Nemipterus mesoprion*
Vernacular Name : 'Kilimeen'/ 'Puthiapla kora'
Gear : Trawl net
Percentage contribution by the gear : 100
Peak period of occurrence : Jun. – Oct.
Depth of occurrence : Upto 75 m
Length range in commercial fishery : 70 – 260 mm
Size at first maturity : 155 mm
Spawning season : Jul. – Nov.

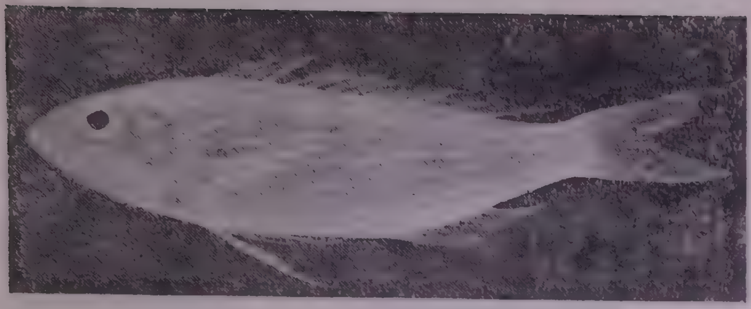

Fig. 39. *Nemipterus delagoae.*

Scientific Name : *Nemipterus delagoae*

Vernacular Name : 'Kilimeen' 'Puthiapla kora'

Gear : Trawl net

Percentage contribution by the gear : 100

Peak period of occurrence : —

Depth of occurrence : Upto 15 m

Length range in commercial fishery : —

Size at first maturity : —

Spawning season : —

PLATYCEPHALIDAE

Popular English Name : Flat head

Vernacular Name (Malayalam) : 'Prathal'/'Eriyan'

Annual average catch : 43.8 t

Percentage in total catch : 0.18

Fishing methods and their contribution : Trawl net : 100%

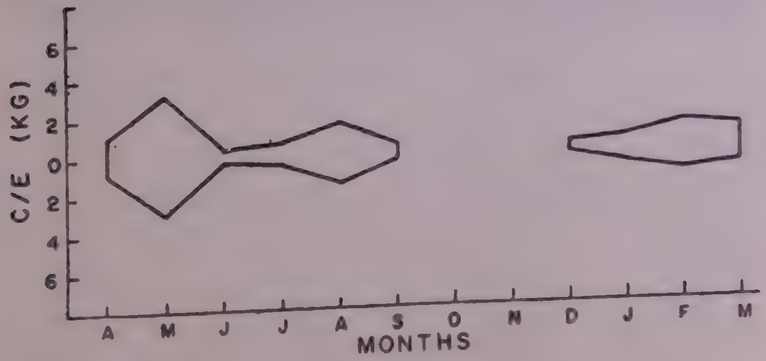

Fig. 40. Seasonal abundance of platycephalids (Trawl net).

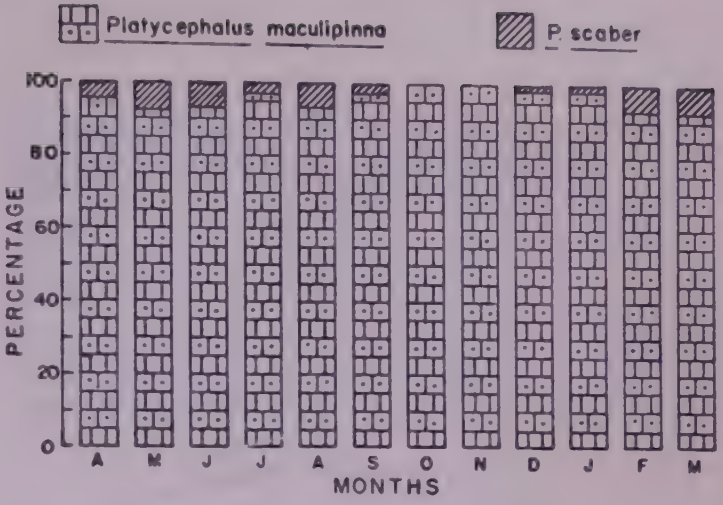

Fig. 41. Monthwise species composition of platycephalids in trawl net.

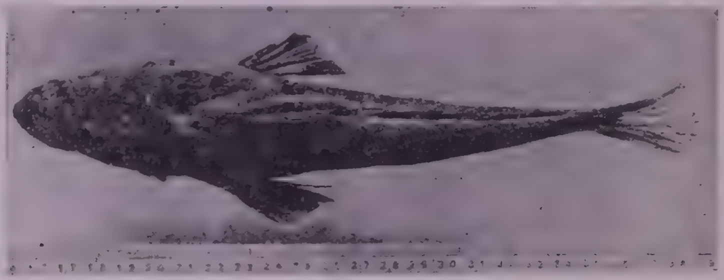

Fig. 42. *Platycephalus maculipinna.*

Scientific Name : *Platycephalus maculipinna*

Vernacular Name : 'Prathal'/'Eriyan'

Gear : Trawl net

Percentage contribution by the gear : 100

Peak period of occurrence : Feb. – Mar. and Jul. – Aug.

Depth of occurrence : Upto 40 m

Length range in commercial fishery : 160 – 290 mm

Size at first maturity : —

Spawning season : —

SCIAENIDAE

Popular English Name : Croaker/Jew fish

Vernacular Name (Malayalam) : 'Kora'/'Kuttan'/'Pallikora'

Annual average catch : 505 t

Percentage in total catch : 2.1

Fishing methods and their contribution : Trawl net : 100%

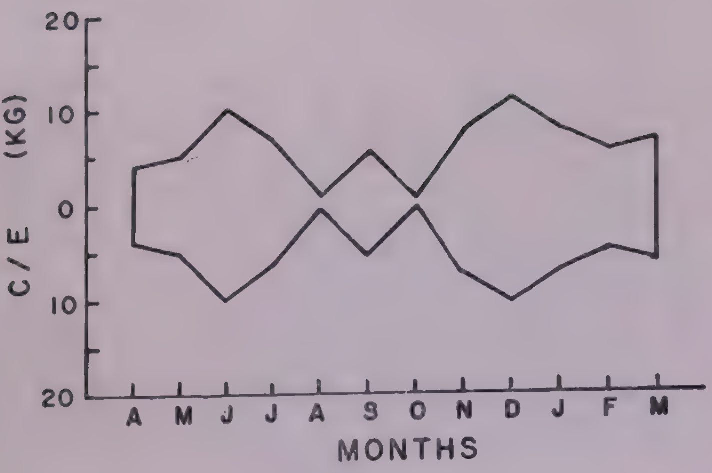

Fig. 43. Seasonal abundance of sciaenids (Trawl net).

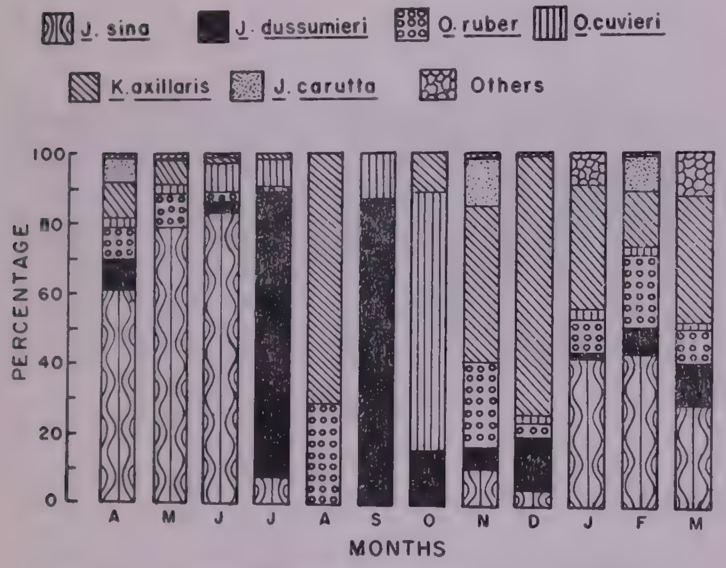

Fig. 44. Monthwise species composition of sciaenids in trawl net

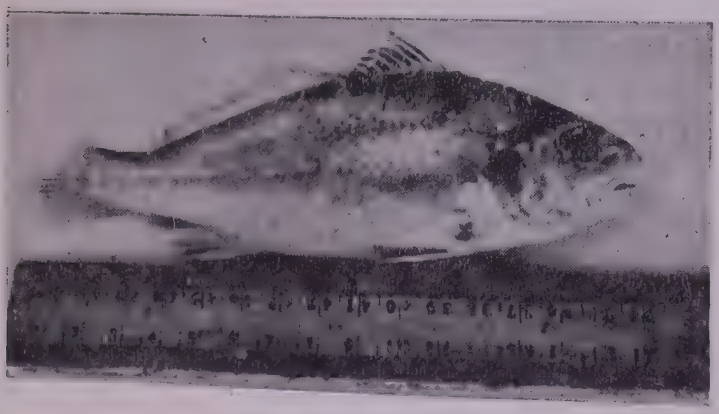

Fig. 45. *Johnieops sina.*

Scientific Name : *Johnieops sina*
Vernacular Name : 'Kora'/'Kuttan'
Gear : Trawl net
Percentage contribution by the gear : 100
Peak period of occurrence : Jan. – May
Depth of occurrence : Upto 40 m
Length range in commercial fishery : 90 – 170 mm
Size at first maturity : 125 mm
Spawning season : Feb. – May

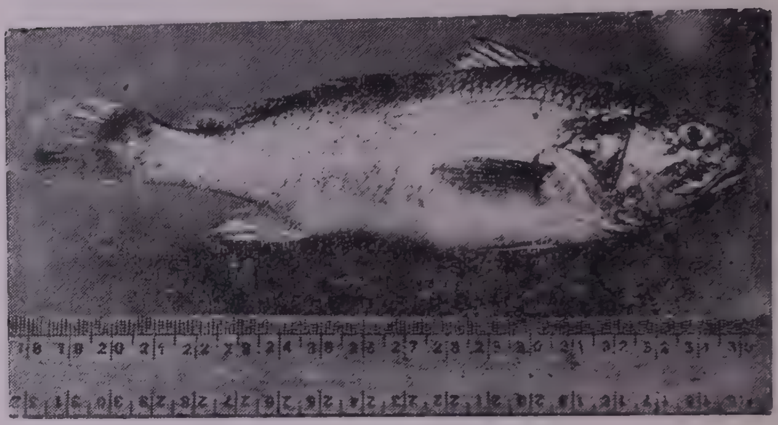

Fig. 46. *Johnieops dussumieri.*

Scientific Name : *Johnieops dussumieri*
Vernacular Name : 'Kuttan'/'Kora'
Gear : Trawl net
Percentage contribution by the gear : 100
Peak period of occurrence : Jun. and Sept. – Dec.
Depth of occurrence : Upto 40 m
Length range in commercial fishery : 85 – 170 mm
Size at first maturity : 125 mm
Spawning season : Nov. – Feb.

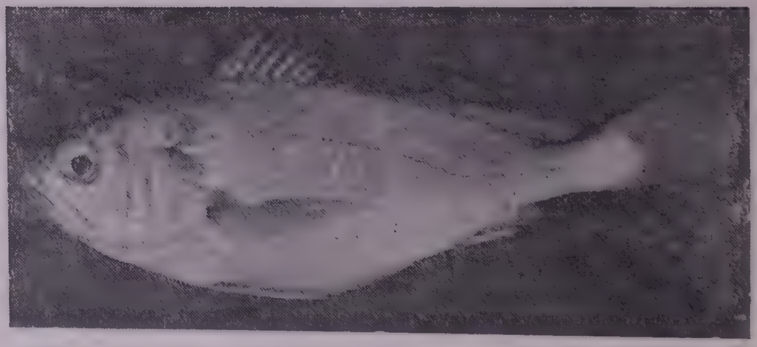

Fig. 47. *Kathala axillaris.*

Scientific Name : *Kathala axillaris*
Vernacular Name : 'Kora'/'Kuttan'
Gear : Trawl net
Percentage contribution by the gear : 100
Peak period of occurrence : Nov. – Feb.
Depth of occurrence : Upto 40 m

Length range in commercial fishery : 95 – 175 mm
Size at first maturity : —
Spawning season : Jun. – Sep.

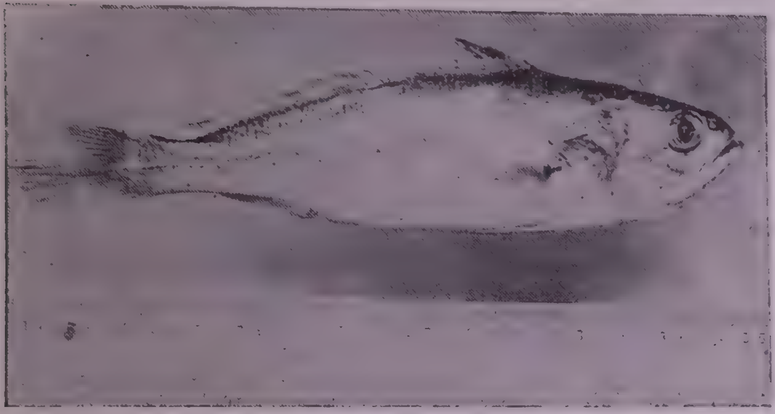

Fig. 48. *Otolithes ruber.*

Scientific Name : *Otolithes ruber*
Vernacular Name : 'Pallikkora'/Kuttan'
Gear : Trawl net
Percentage contribution by the gear : 100
Peak period of occurrence : Jan. – Apr.
Depth of occurrence : Upto 40 m
Length range in commercial fishery : 85 – 250 mm
Size at first maturity : —
Spawning season : Jun. – Oct.

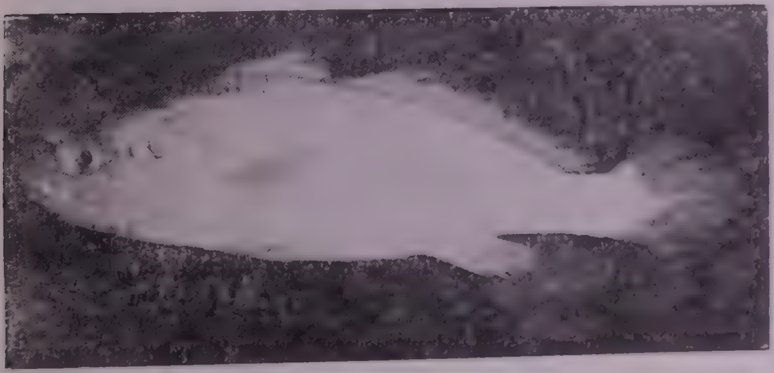

Fig. 49. *Otolithes cuvieri.*

Scientific Name : *Otolithes cuvieri*
Vernacular Name : 'Pallikkora'/Kuttan'
Gear : Trawl net
Percentage contribution by the gear : 100
Peak period of occurrence : Apr. – Mar.
Depth of occurrence : Upto 40 m
Length range in commercial fishery : 80 – 240 mm
Size at first maturity : —
Spawning season : Jun. - Oct.

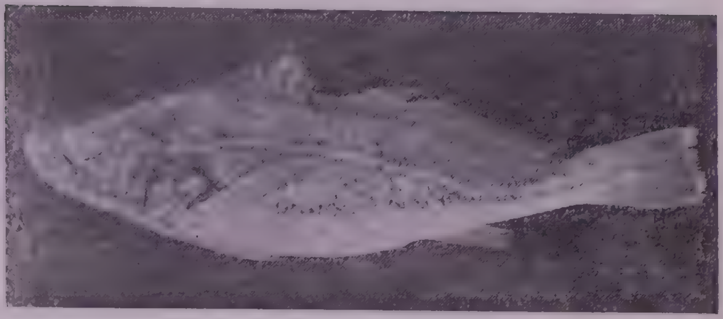

Fig. 50. *Johnius carutta.*

Scientific Name : *Johnius carutta*
Vernacular Name : 'Kora'/'Kuttan'
Gear : Trawl net
Percentage contribution by the gear : 100
Peak period of occurrence : Nov. – Dec. and Feb.
Depth of occurrence : Upto 40 m
Length range in commercial fishery : 90 - 170 mm
Size at first maturity : —
Spawning season : —

SCOMBRIDAE

Popular English Name : Mackerel/Tunas/ Seer fishes
Vernacular Name (Malayalam) : 'Ayila'/'Choora'/ 'Neimeen'/'Arkiah'
Annual average catch : 3,985 t
Percentage in total catch : 16.2
Fishing methods and their contribution : Purse seine : 58.2%
Drift net : 41.0%
Trawl net : 0.8%

MACKEREL

Popular English Name : Indian mackerel
Vernacular Name (Malayalam) : 'Ayila'
Annual average catch : 2,743 t
Percentage in total catch : 11.6
Fishing methods and their contribution : Purse seine : 97.9%
Drift net : 1.7%
Trawl net : 0.4%

Scientific Name : *Rastrelliger kanagurta*

Vernacular Name : 'Ayila'

Gear : Purse seine/Drift net/Trawl net

Percentage contribution by each gear : Purse seine : 97.9
Drift net : 1.7
Trawl net : 0.4

Peak period of occurrence : Sep. – Nov.

Depth of occurrence : Upto 50 m

Length range in commercial fishery : 160 – 240 mm

Size at first maturity : 220 mm

Spawning season : Jun. – Aug.

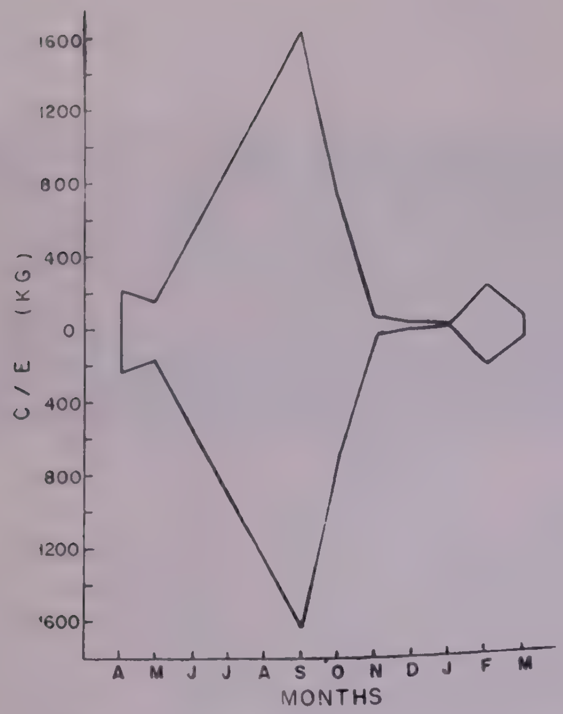

Fig. 51. Seasonal abundance of mackerel (Purse seine).

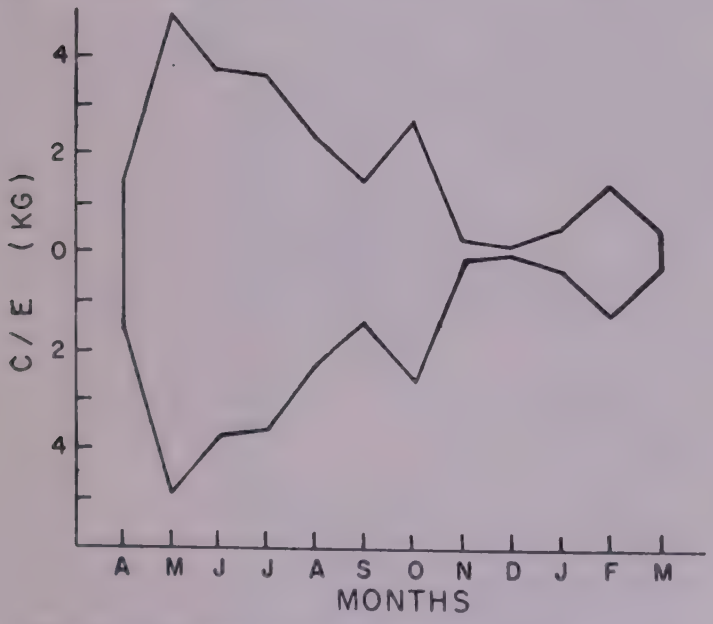

Fig. 52. Seasonal abundance of mackerel (Drift net).

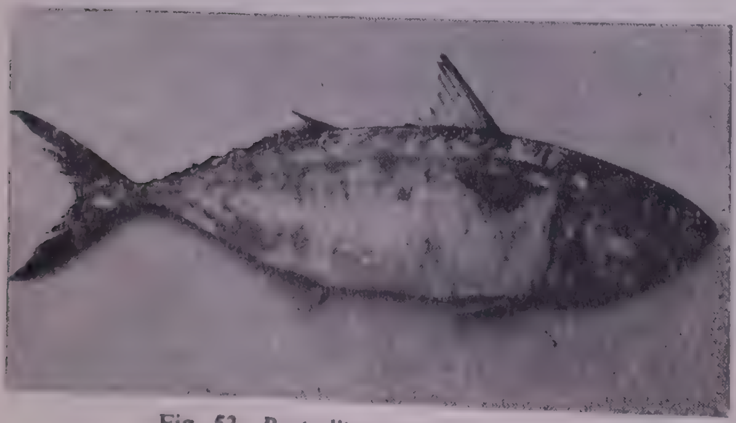

Fig. 53. *Rastrelliger kanagurta.*

TUNAS

Popular English Name : Tunas

Vernacular Name (Malayalam) : 'Choora'

Annual average catch : 770 t

Percentage in total catch : 3.3

Fishing methods and their contribution : Drift net : 97.6%
Purse seine : 2.4%

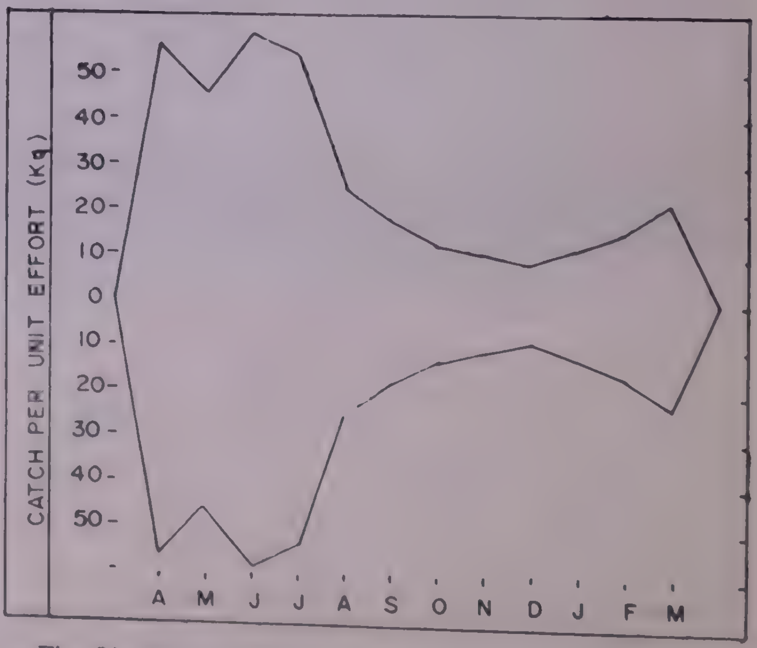

Fig. 54. Seasonal abundance of tunas (Drift net).

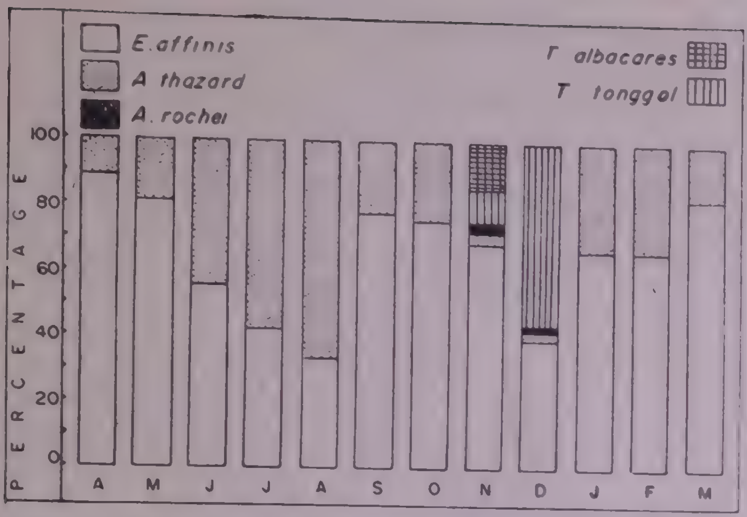

Fig. 55. Monthly species composition of tunas in drift net.

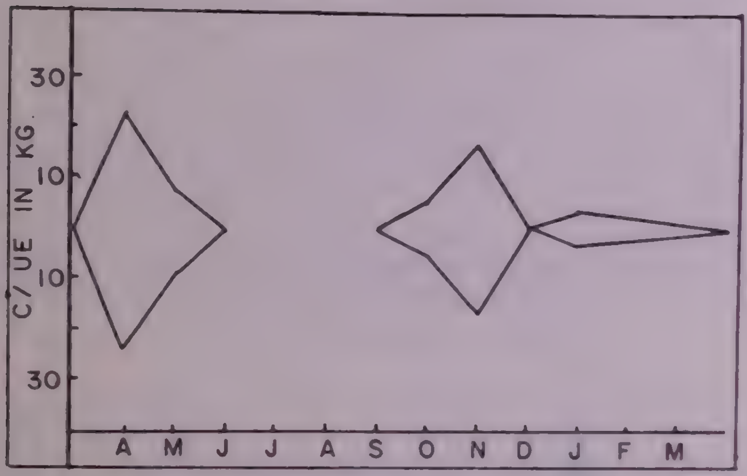

Fig. 56. Seasonal abundance of tunas (Purse seine).

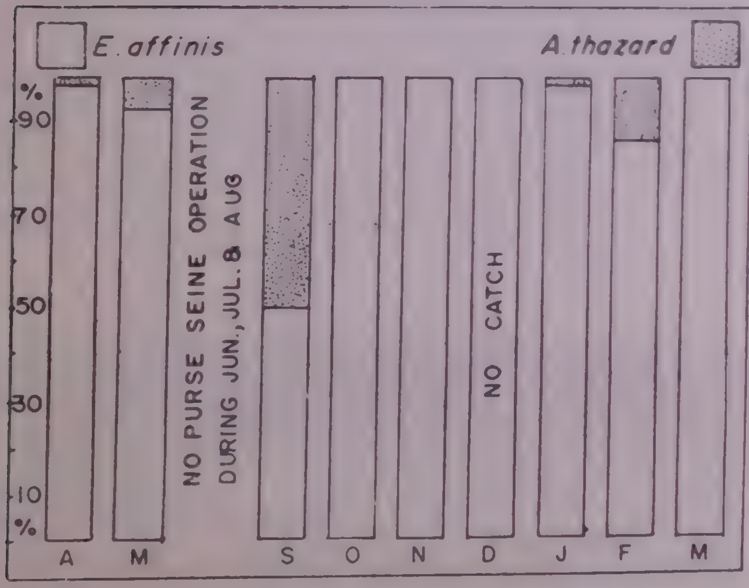

Fig. 57. Monthly species composition of tunas in purse seine.

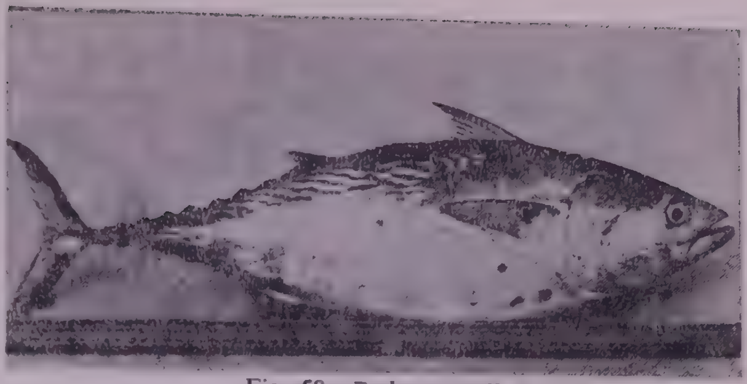

Fig. 58. *Euthynnus affinis.*

Scientific Name : *Euthynnus affinis*
Vernacular Name : 'Choora'
Gear : Drift net/Purse seine
Percentage contribution by each gear : Drift net : 99.6
Purse seine : 0.4
Peak period of occurrence : Apr. – Nov.
Depth of occurrence : 20 – 40 m
Length range in commercial fishery : 220 – 720 mm
Size at first maturity : 420 – 430 mm
Spawning season : Oct. – Mar.

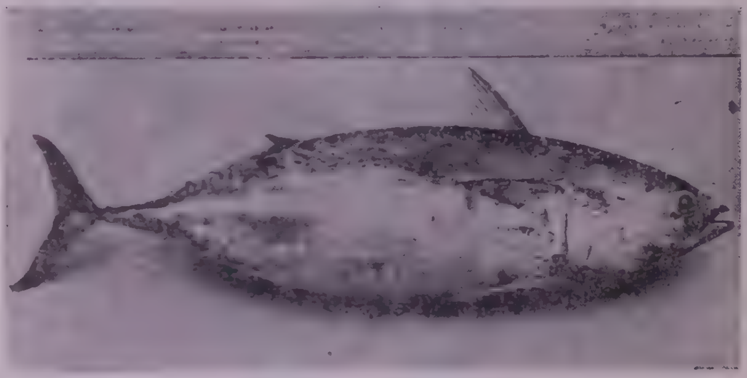

Fig. 59. *Auxis thazard.*

Scientific Name : *Auxis thazard*
Vernacular Name : 'Kudutha'
Gear : Drift net/Purse seine
Percentage contribution by each gear : Drift net : 98.6
Purse seine : 1.4
Peak period of occurrence : Apr.– Nov.
Depth of occurrence : 20 – 40 m
Length range in commercial fishery : 200 – 480 mm
Size at first maturity : 300 mm
Spawning season : Oct. – Dec.

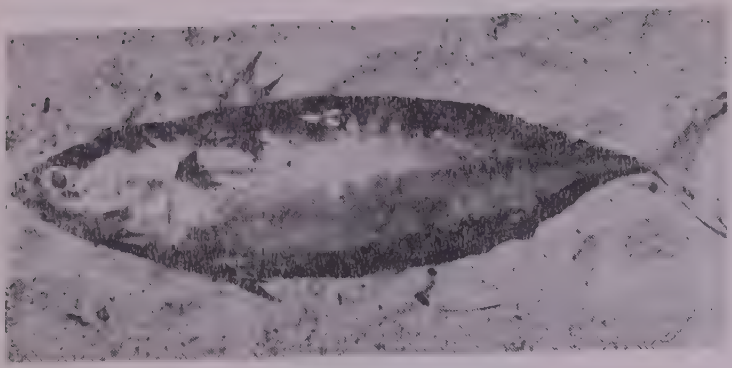

Fig. 60. *Auxis rochei.*

Scientific Name : *Auxis rochei*
Vernacular Name : 'Elichoora'
Gear : Drift net/Purse seine
Percentage contribution by each gear : Drift net : 90.9
Purse seine : 9.1
Peak period of occurrence : Jul. – Nov.
Depth of occurrence : 30 – 40 m
Length range in commercial fishery : 200 – 320 mm
Size at first maturity : 240 mm
Spawning season : September

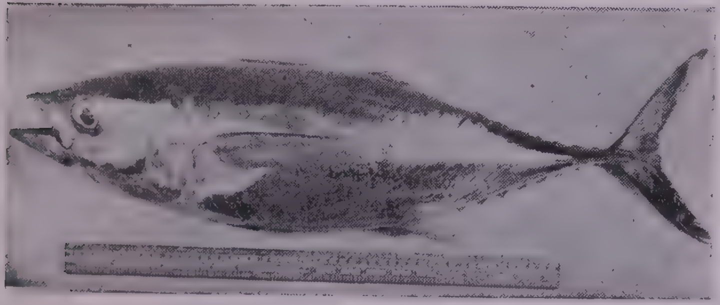

Fig. 61. *Thunnus albacares.*

Scientific Name : *Thunnus albacares*
Vernacular Name : 'Manja choora'
Gear : Drift net
Percentage contribution by the gear : 100
Peak period of occurrence : Feb. – Aug.
Depth of occurrence : 30 – 40 m
Length range in commercial fishery : 500 – 1,200 mm
Size at first maturity : —
Spawning season : —

SEER FISHES

Popular English Name : Seer fishes
Vernacular Name (Malayalam) : 'Neimeen'/'Arkiah'
Annual average catch : 472 t
Percentage in total catch : 2.0
Fishing methods and their contribution : Trawl net : 0.2%
Drift net : 99.8%

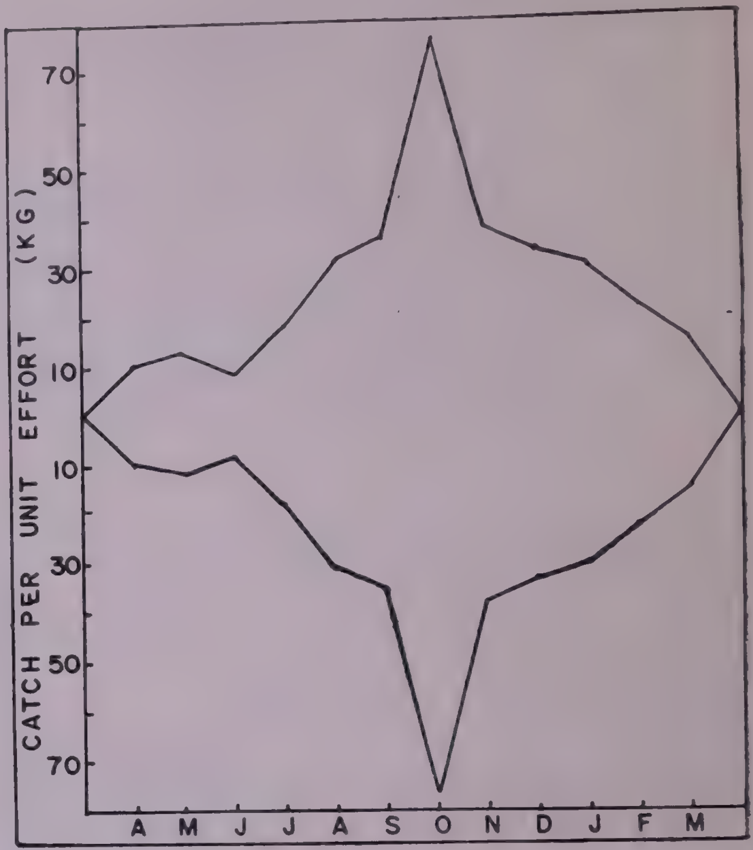

Fig. 62. Seasonal abundance of seer fishes (Drift net).

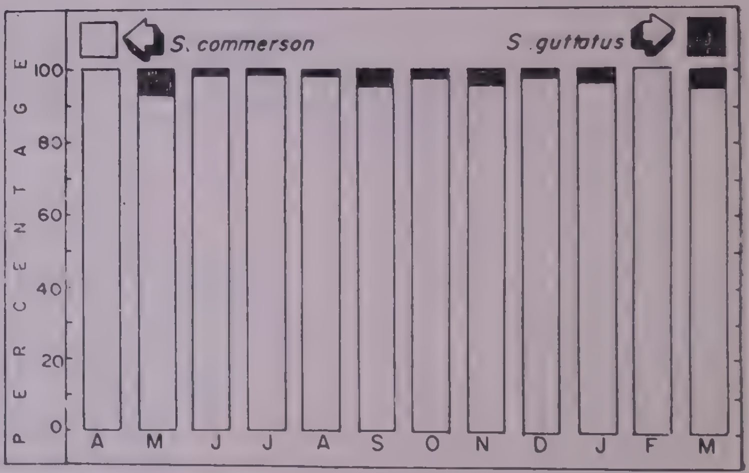

Fig. 63. Monthly species composition of seer fishes in drift net catch.

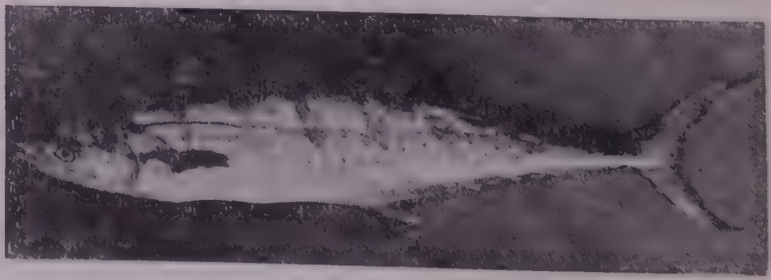

Fig. 64. *Scomberomorus commerson.*

Scientific Name : *Scomberomorus commerson*
Vernacular Name : 'Neimeen'/'Arkiah'
Gear : Drift net
Percentage contribution by the gear : 100
Peak period of occurrence : Aug. – Sep.
Depth of occurrence : 30 – 40 m
Length range in commercial fishery : 350 – 1,250 mm
Size at first maturity : 750 mm
Spawning season : Jan. – Sep.

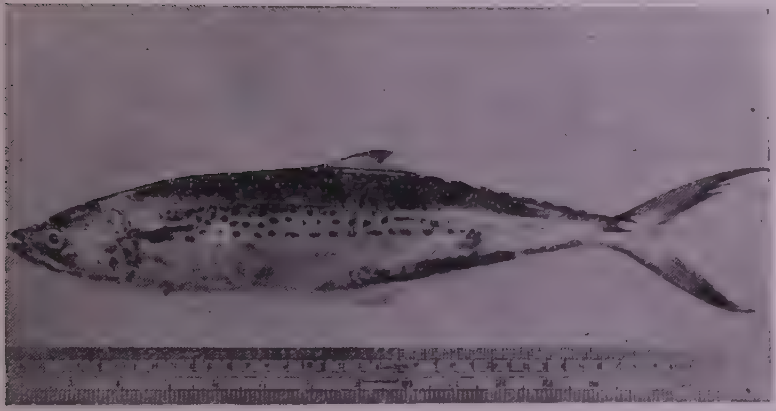

Fig. 65. *Scomberomorus guttatus.*

Scientific Name : *Scomberomorus guttatus*
Vernacular Name : 'Neimeen'/'Arkiah'
Gear : Drift net
Percentage contribution by the gear : 100
Peak period of occurrence : Sept. – Nov.
Depth of occurrence : 30 – 40 m
Length range in commercial fishery : 300 – 500 mm
Size at first maturity : —
Spawning season : —

SERRANIDAE

Popular English Name : Reef cod/Grouper
Vernacular Name (Malayalam) : 'Kalava'
Annual average catch : 19.8 t
Percentage in total catch : 0.1
Fishing methods and their contribution : Hooks & line : 100%

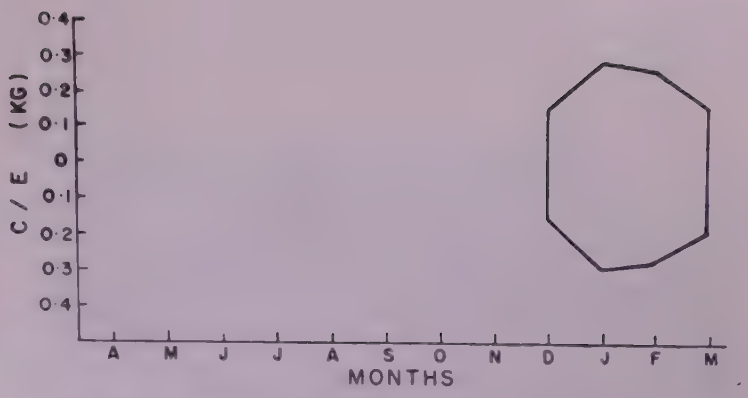

Fig. 66. Seasonal abundance of perches (Hooks and line).

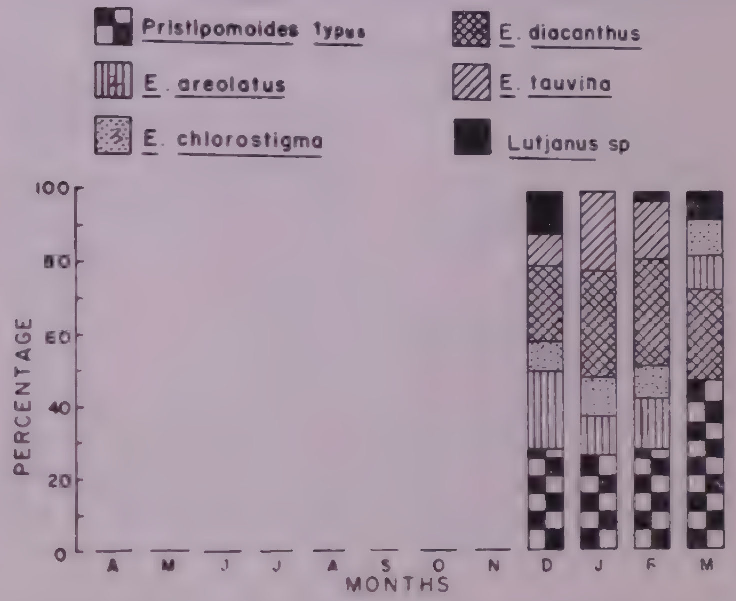

Fig. 67. Monthwise species composition of perches in hooks and line.

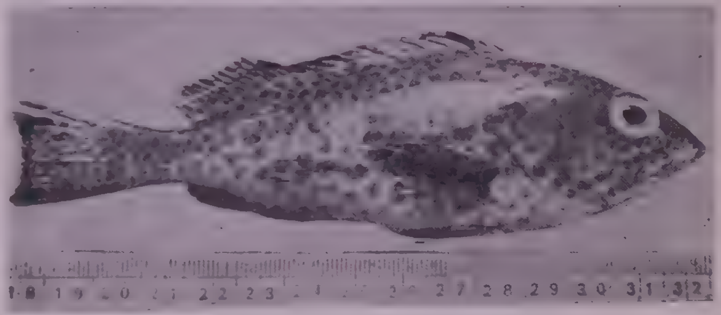

Fig. 68. *Epinephelus areolatus.*

Scientific Name : *Epinephelus areolatus*
Vernacular Name : 'Kalava'
Gear : Hooks and line
Percentage contribution by the gear : 100
Peak period of occurrence : Jan. – Feb.
Depth of occurrence : 50 m
Length range in commercial fishery : 290 – 650 mm

Size at first maturity : —
Spawning season : —

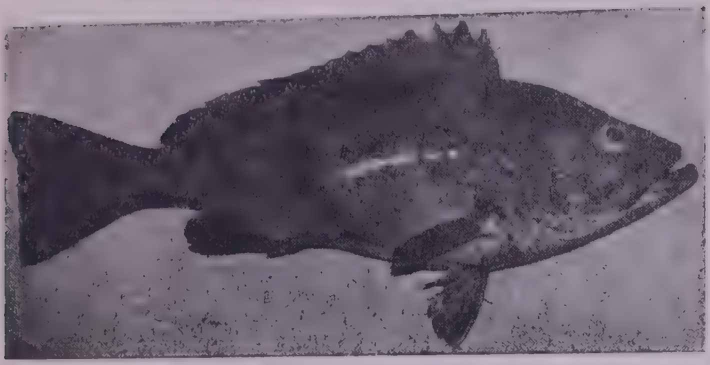

Fig. 69. *Epinephelus chlorostigma.*

Scientific Name : *Epinephelus chlorostigma*
Vernacular Name : 'Kalava'
Gear : Hooks and line
Percentage contribution by the gear : 100
Peak period of occurrence : Jan. – Feb.
Depth of occurrence : 50 m
Length range in commercial fishery : 270 – 580 mm
Size at first maturity : —
Spawning season : —

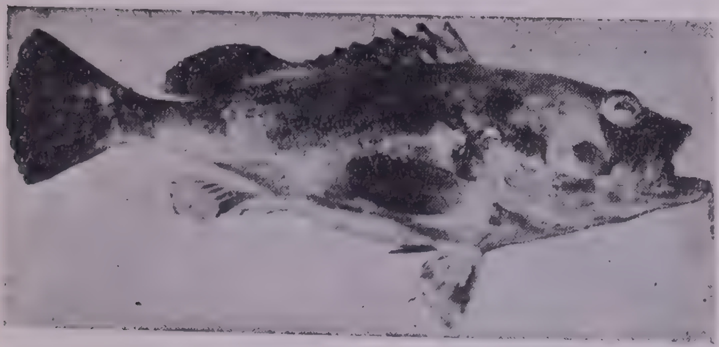

Fig. 70. *Epinephelus diacanthus.*

Scientific Name : *Epinephelus diacanthus*
Vernacular Name : 'Kalava'
Gear : Hooks and line
Percentage contribution by the gear : 100
Peak period of occurrence : Jan. – Feb.
Depth of occurrence : 50 m
Length range in commercial fishery : 190 – 620 mm
Size at first maturity : —
Spawning season : —

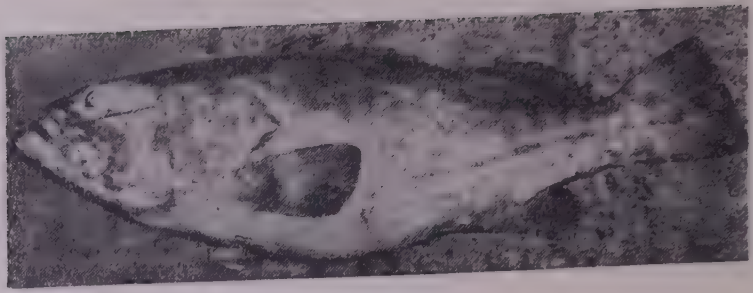

Fig. 71. *Epinephelus tauvina.*

Scientific Name : *Epinephelus tauvina*
Vernacular Name : 'Kalava'
Gear : Hooks and line
Percentage contribution by the gear : 100
Peak period of occurrence : Jan. – Feb.
Depth of occurrence : 50 m
Length range in commercial fishery : 300 – 970 mm
Size at first maturity : —
Spawning season : —

LUTJANIDAE

Popular English Name : Bass
Vernacular Name (Malayalam) : 'Chemballi'/'Kalava'
Annual average catch : 7.8 t
Percentage in total catch : 0.03
Fishing methods and their contribution : Hooks and line

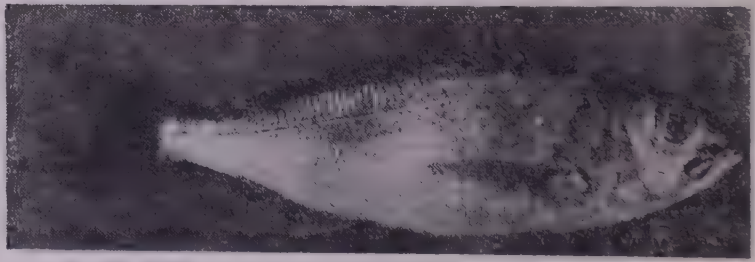

Fig. 72. *Pristipomoides typus.*

Scientific Name : *Pristipomoides typus*
Vernacular Name : 'Chemballi'/'Kalava'
Gear : Hooks and line
Percentage contribution by the gear : 100
Peak period of occurrence : Jan. – Feb.
Depth of occurrence : 50 m
Length range in commercial fishery : 210 – 590 mm
Size at first maturity : —
Spawning season : —

STROMATEIDAE

Popular English Name : Pomfrets
Vernacular Name (Malayalam) : 'Machan'/'Avoli'
Annual average catch : 271 t
Percentage in total catch : 1.01
Fishing methods and their contribution : Purse seine : 56.9%
Drift net : 38.6%
Trawl net : 4.5%

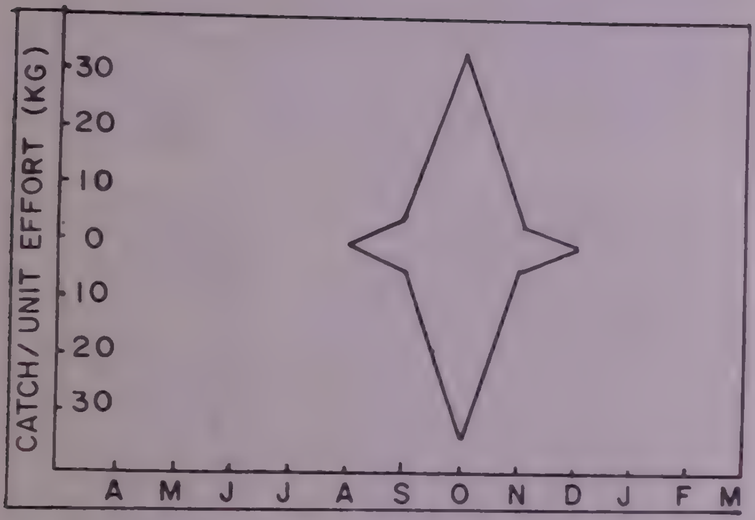

Fig. 73. Seasonal abundance of pomfrets (Purse seine).

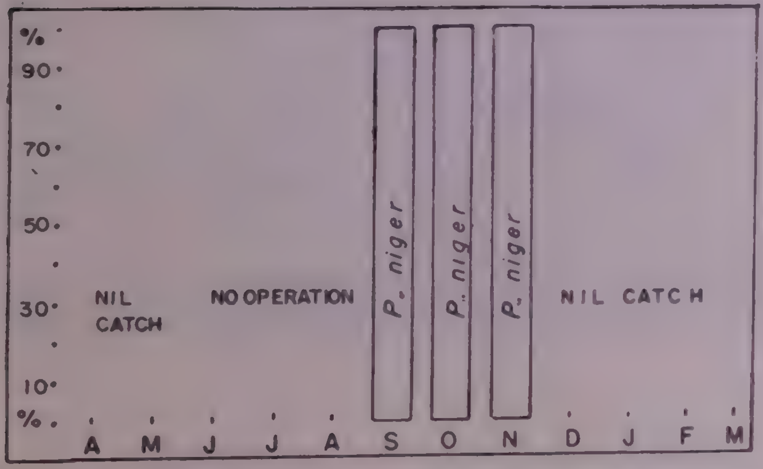

Fig. 74. Monthwise species composition of pomfrets in purse seine catch.

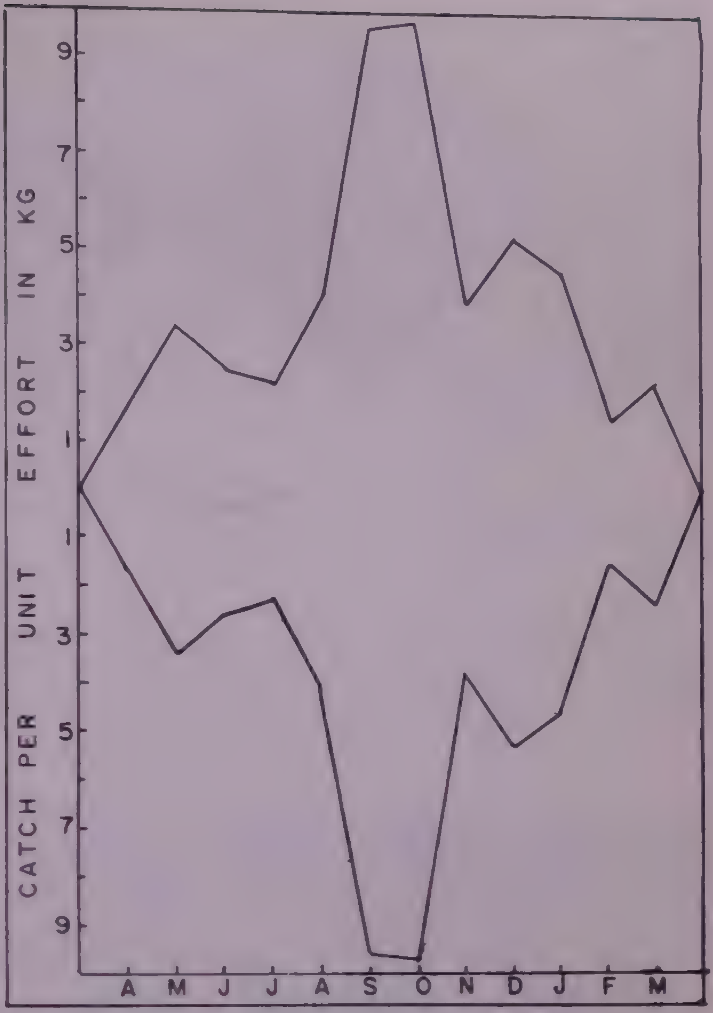

Fig. 75. Seasonal abundance of pomfrets (Drift net).

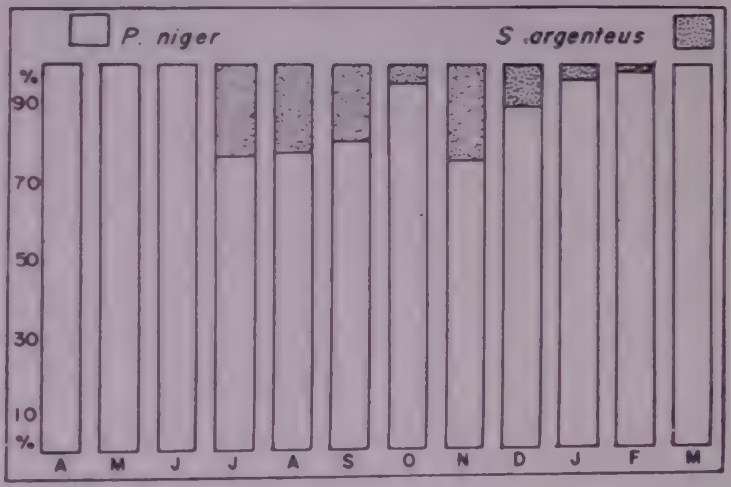

Fig. 76. Monthwise species composition of pomfrets in drift net catch.

Scientific Name : *Parastromateus niger*
Vernacular Name : 'Machan'/'Avoli'
Gear : Drift net/Purse seine
Percentage contribution by each gear : Drift net : 77
Purse seine : 23

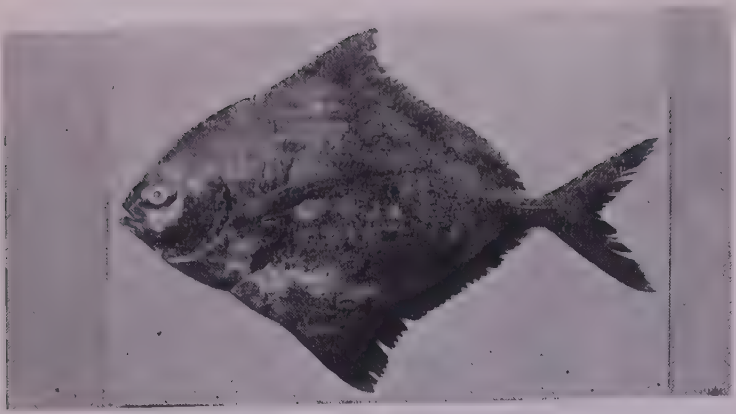

Fig. 77. *Parastromateus niger.*

Peak period of occurrence : Aug. – Nov.
Depth of occurrence : 30 – 40 m

Length range in commercial fishery : 180 – 520 mm
Size at first maturity : 280 mm
Spawning season : Sep. – Dec. & Feb.

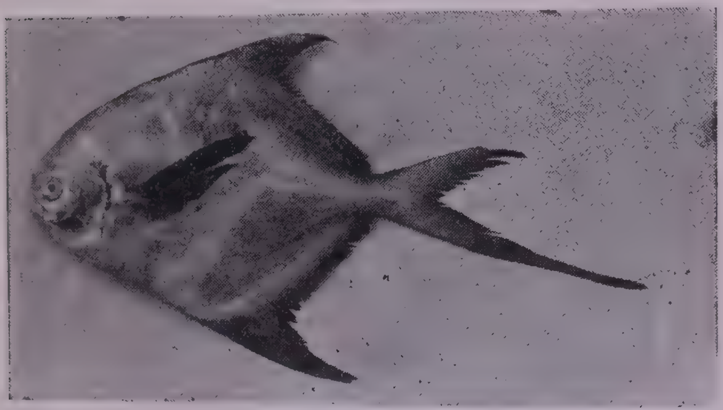

Fig. 78. *Pampus argenteus.*

Scientific Name : *Pampus argenteus*
Vernacular Name : 'Vella avoli'
Gear : Trawl/Drift net
Percentage contribution by each gear : Trawl net : 83.3
Drift net : 16.7
Peak period of occurrence : Aug. – Oct.
Depth of occurrence : 25 – 40 m
Length range in commercial fishery : 100 – 350 mm
Size at first maturity : —
Spawning season : —

SYNODONTIDAE

Popular English Name : Lizard fishes
Vernacular Name (Malayalam) : 'Arana meen'

Annual average catch : 430 t
Percentage in total catch : 1.8
Fishing methods and their contribution : Trawl net : 100%

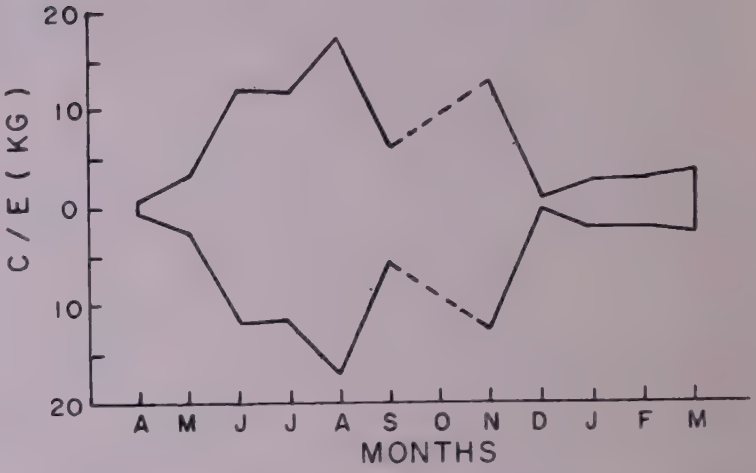

Fig. 79. Seasonal abundance of lizard fishes (Trawl net).

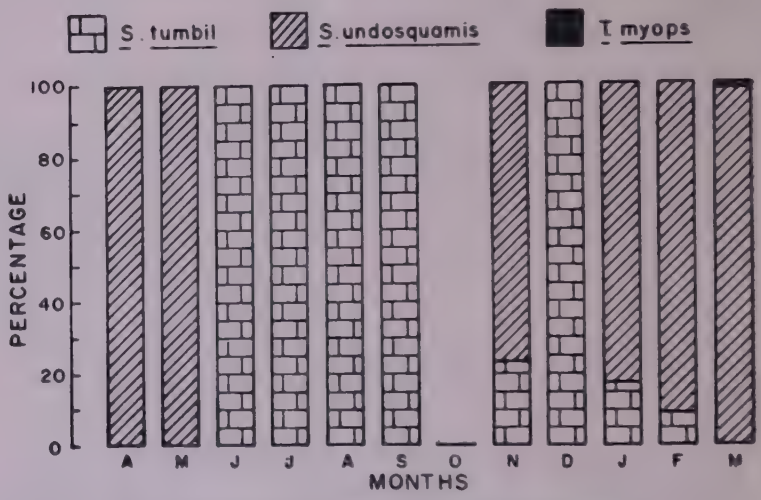

Fig. 80. Monthwise species composition of lizard fishes in trawl catches.

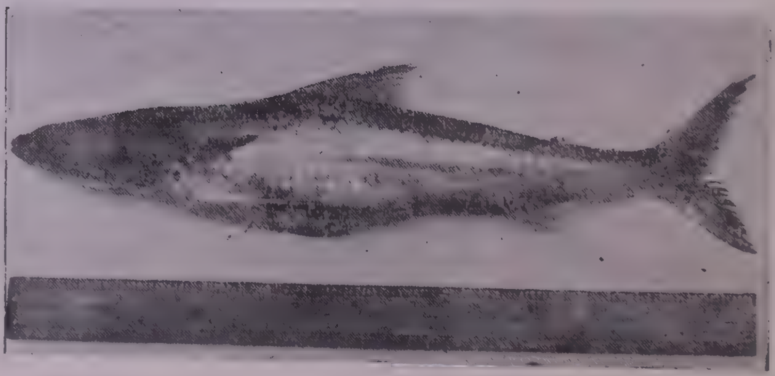

Fig. 81. *Saurida tumbil.*

Scientific Name : *Saurida tumbil*
Vernacular Name : 'Arana meen'
Gear : Trawl net

Percentage contribution
by the gear : 100
Peak period of occurrence : Jan. – Sep.
Depth of occurrence : Upto 70 m
Length range in
commercial fishery : 160 – 420 mm
Size at first maturity : —
Spawning season : May – Sep.

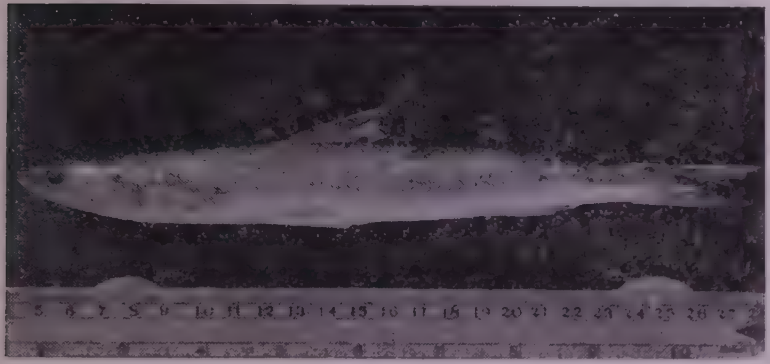

Fig. 82. *Saurida undosquamis.*

Scientific Name : *Saurida undosquamis*
Vernacular Name : 'Arana meen'
Gear : Trawl net
Percentage contribution
by the gear : 100
Peak period of occurrence : Apr. – May; Nov. and Jan. – Feb.
Depth of occurrence : Upto 70 m
Length range in
commercial fishery : 90 – 200 mm
Size at first maturity : —
Spawning season : Nov. and Jan. – Feb.

TACHYSURIDAE

Popular English Name : Cat fishes
Vernacular Name (Malayalam) : 'Aetta'/'Koori'
Annual average catch : 695.5 t
Percentage in total catch : 0.03
Fishing methods and
their contribution : Drift net : 55.8 %
Trawl net : 41.4 %
Purse seine : 2.8 %

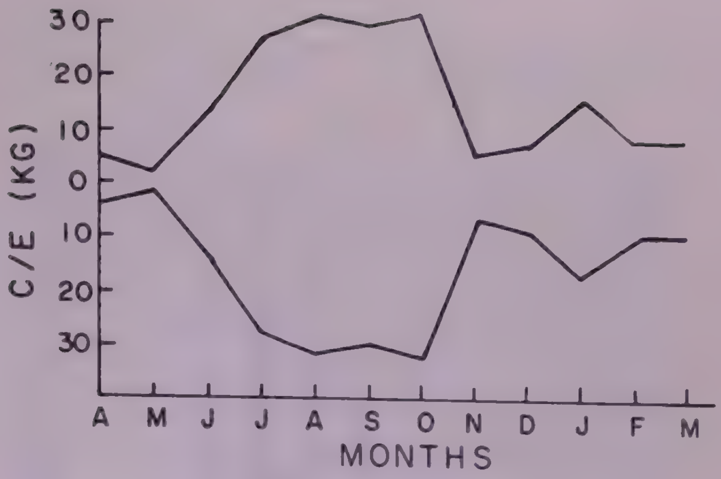

Fig. 83. Seasonal abundance of cat fishes (Drift net).

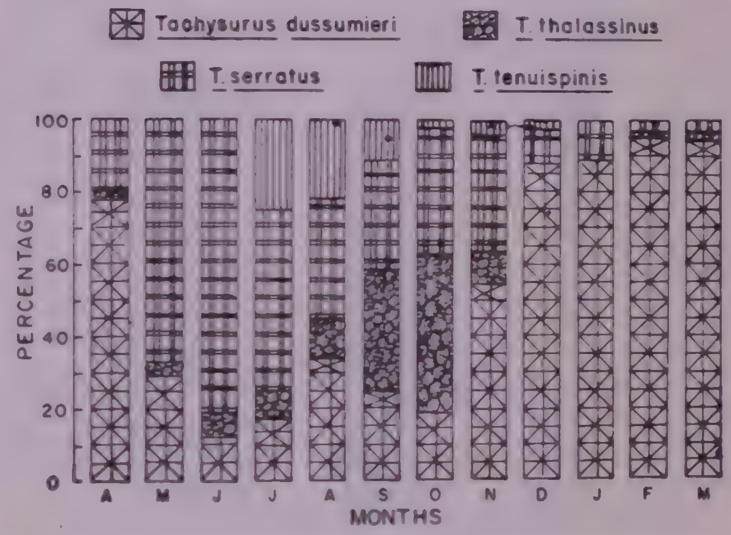

Fig. 84. Monthwise species composition of cat fishes in drift net.

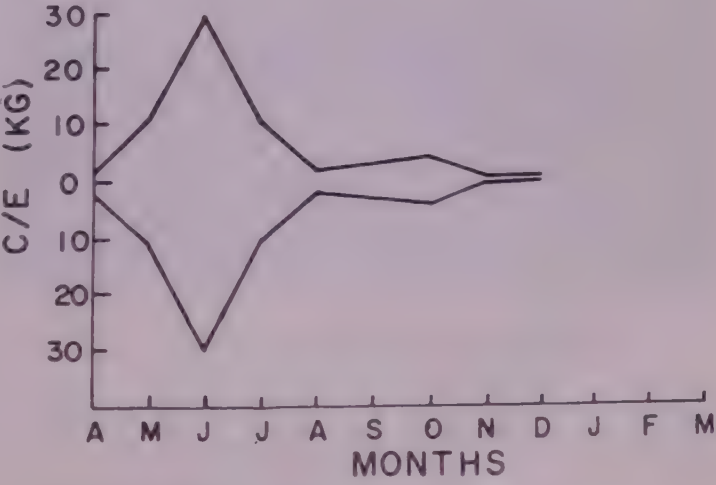

Fig. 85. Seasonal abundance of cat fishes (Trawl net).

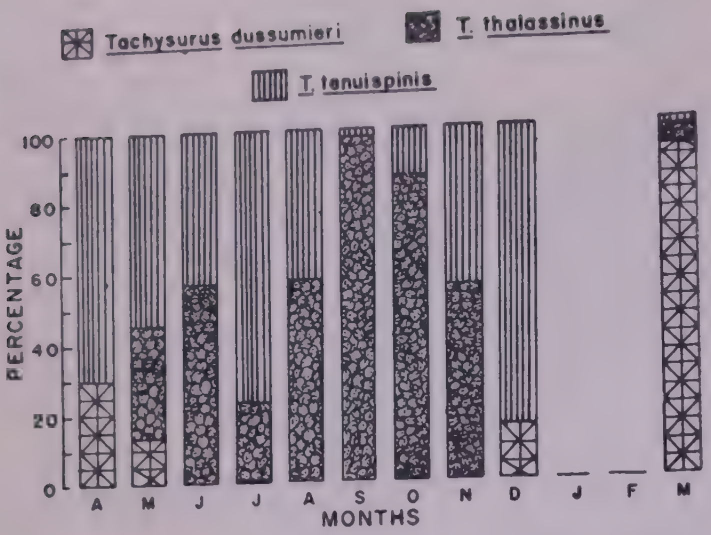

Fig. 86. Monthwise species composition of cat fishes in trawl net.

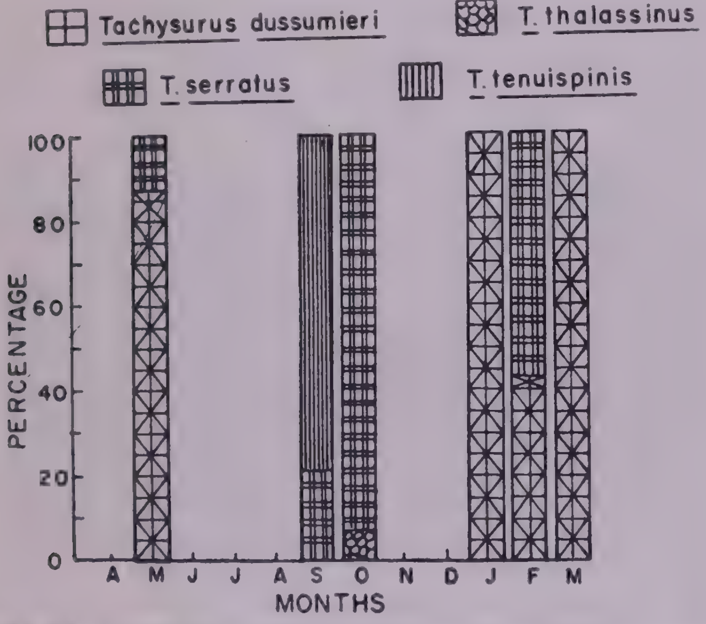

Fig. 87. Monthwise species composition of cat fishes in purse seine.

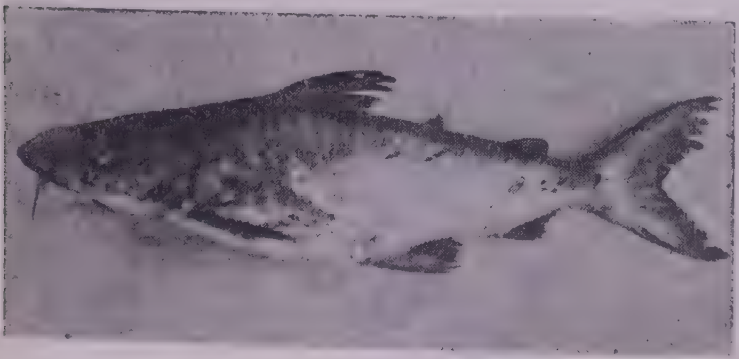

Fig. 88. *Tachysurus dussumieri.*

Scientific Name : *Tachysurus dussumieri*
Vernacular Name : 'Valiaetta'
Gear : Drift net/Trawl net/ Purse seine
Percentage contribution by each gear : Drift net : 79.2
Trawl net : 11.8
Purse seine : 9.0
Peak period of occurrence : Jul. – Feb.
Depth of occurrence : Upto 70 m
Length range in commercial fishery : 500 – 800 mm
Size at first maturity : 520 mm
Spawning season : Sep. – Jan.

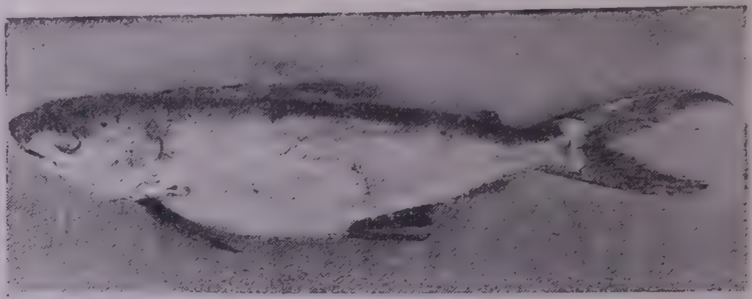

Fig. 89. *Tachysurus thalassinus.*

Scientific Name : *Tachysurus thalassinus*
Vernacular Name : 'Valiaetta'
Gear : Drift net/Trawl net/ Purse seine
Percentage contribution by each gear : Trawl net : 63.1
Drift net : 36.8
Purse seine : 0.1
Peak period of occurrence : May – Oct.
Depth of occurrence : Upto 70 m
Length range in commercial fishery : 300 – 600 mm
Size at first maturity : 370 mm
Spawning season : Aug. – Oct.

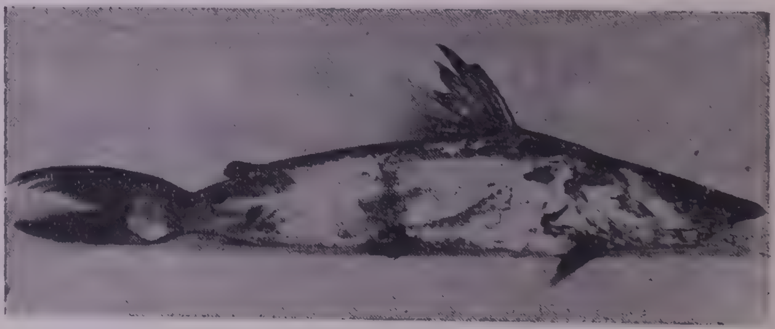

Fig. 90. *Tachysurus serratus.*

Scientific Name : *Tachysurus serratus*
Vernacular Name : 'Navetta'
Gear : Drift net/Trawl net/ Purse seine

Percentage contribution by each gear : Drift net : 96.0
Purse seine : 3.0
Trawl net : 1.0
Peak period of occurrence : June – Oct.
Depth of occurrence : Upto 70 m
Length range in commercial fishery : 600 – 900 mm
Size at first maturity : 600 mm
Spawning season : Sep. – Oct.

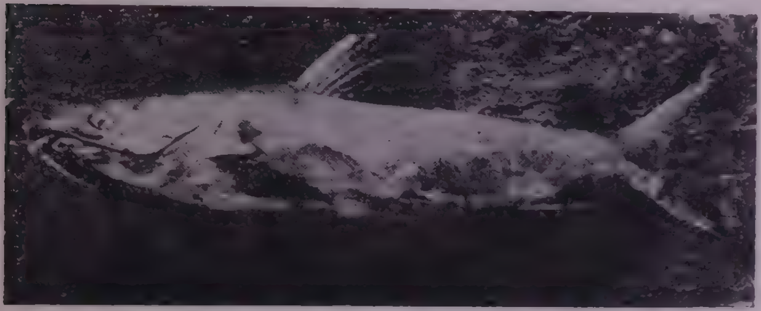

Fig. 91. *Tachysurus tenuispinis.*

Scientific Name : *Tachysurus tenuispinis*
Vernacular Name : 'Urianetta'
Gear : Drift net/Trawl net/Purse seine
Percentage contribution by each gear : Trawl net : 74.4
Drift net : 24.7
Purse seine : 0.9
Peak period of occurrence : May – Oct.
Depth of occurrence : Upto 80 m
Length range in commercial fishery : 300 – 450 mm
Size at first maturity : 320 mm
Spawning season : Apr. – Sep.

MONSOON PRAWN FISHERY BY 'MATABALA' ALONG THE MANGALORE COAST—A CRITICAL STUDY*

The mechanisation of fishing by the introduction of trawlers for prawns and ground fishes in the early 1960s and purse seines for pelagic resources in the late 1970s has revolutionised the fishing industry in Karnataka. However, when all these mechanised fishing operations remain suspended along this coast during the southwest monsoon period (June – August), traditional gears are operated mainly to catch large sized prawns. The introduction of 'matabala' in the 1984 season along the Mangalore coast and the subsequent additions in the following seasons, boosted the prawn landings during the monsoon season. These 'matabala' units, despite the weather conditions, could operate their nets without any difficulty since they are powered by outboard engines. It has created unprecedented rivalry between fishermen of the 'matabala' and the mechanised fishing boats which led to clashes resulting in law and order problem in this area. With this background information, a critical study of the 'matabala' prawn fishery during 1986 season was made and the results are given in the present account.

'Matabala'—A miniature purse seine

'Matabala' also known as 'Disco net' is a small version of purse seine net made of nylon, measuring about 240 m in length and 10 – 12 m in width with a mesh size of 10 – 18 mm. These nets are coloured orange, blue, pink, dark brown or green to ward off puffer fish which otherwise cause considerable damage to these nets.

A 'matabala' fishing unit may be owned by a group of 30 – 35 fishermen. A unit consisting of one net, three plank built canoes and three outboard engines may altogether cost Rs. 1.85 to 2.0 lakhs. Out of the total cost, 50–75% of the amount is loaned by private agencies and the rest contributed by members of the 'matabala' unit. A good number of units are also financed by South Kanara Co-operative Fish Marketing Federation, Mangalore.

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*Prepared by K. K. Sukumaran, Alli C. Gupta, Uma S. Bhat, D. Nagaraja, H. Ramachandra, O. Thippeswamy and Y. Munyappa, Mangalore Research Centre of CMFRI, Mangalore.

Mode of operation

This net is operated from two plank–built canoes, each measuring 6–7 m in length, fitted with outboard engines. Most of them use either 'Yamaha' or 'Suzuki' engines. A few are found to use 'Johnson' eventhough it is run by petrol. Generally, 8 or 15 HP engines are used.

Each canoe carries a part of 'matabala' net (120 m in length, each part consisting of 11 net pieces of 10–11 m length). At the time of operation, 2 such parts are joined together so as to make a net of 240 m length. After citing a shoal, the net is released. One end of the net will be kept with one canoe which will remain stationary, while the other end of the net is taken round by another canoe encircling the shoal. After bringing both ends of the net together the bottom rope is pulled and the net is hauled slowly. To prevent the fishprawns jumping out of the net, the upper edge of the net is slightly lifted above the water level by one of the canoes while hauling it. Depending on the size of the shoal, the time taken for a haul varies from half-an-hour to one hour. The number of hauls vary from 1–4 per day. When the catches are high, each unit may employ one or two canoes (with or without outboard engines) as carrier boats for transporting a part of their catch as it is done by purse seines.

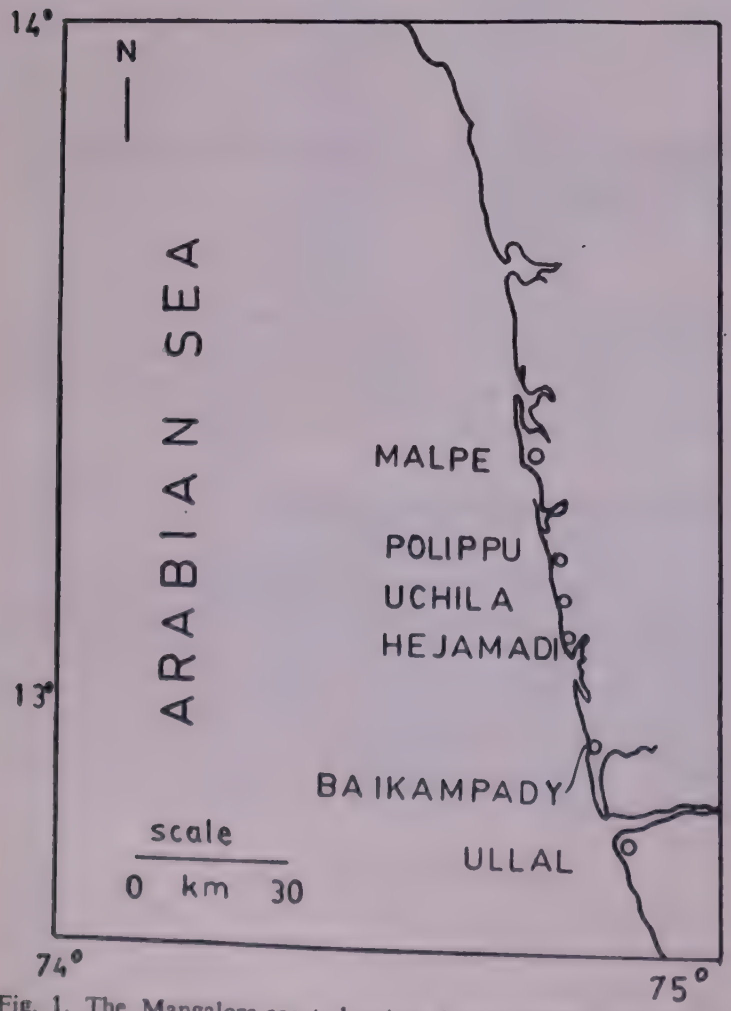

Fig. 1. The Mangalore coast showing the important 'matabala' fish landing centres.

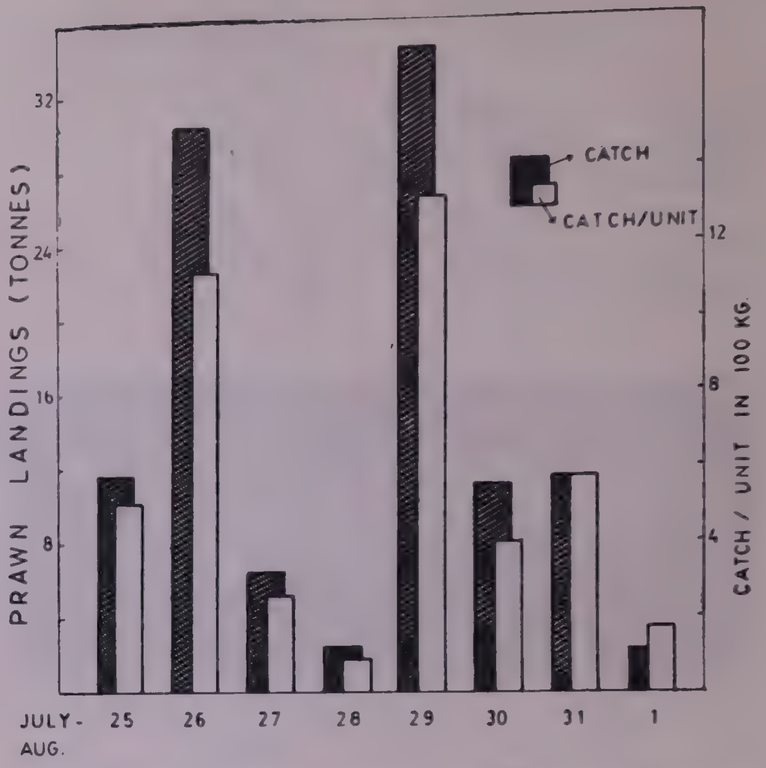

Fig. 2. Prawn landings by 'matabala' at Ullal during July-Aug. 1986.

Area and period of operation

The 'matabala' units are operated all along the Mangalore coast when there is lull in monsoon and sea conditions permitted these fishermen to venture into the sea. However, most of these units are centred around Ullal, Baikampady (Panambur Harbour), Uchila, Hejamadi, Polippu and Malpe (Fig. 1). Fishing operations are generally confined to nearshore waters within 15 m depth.

It is seen that monsoon fishery along this coast largely depends on the weather conditions as well as the availability of shoals. Due to this, there has not been any consistency in the fishing operations. Regular catch statistics and other biological data were collected only from Ullal and Baikampady. Information regarding the prawn landings at other centres were collected by enquiry.

'Matabala' fishery at Ullal and Baikampady

Ullal: It is estimated that 110.6 t of prawns landed during 1986 with a catch rate per boat-day of 384 kg as against 61.6 t and 517 kg obtained in the 1985 season. The catch per boat-day ranged widely from a minimum of 167 kg on 1st August 1986 to a maximum of 1,332 kg on 29th July '86 (Fig. 2). All the prawn catch was obtained between 25th July and 1st August '86. Of this, 97.9% was landed in July and the rest in August.

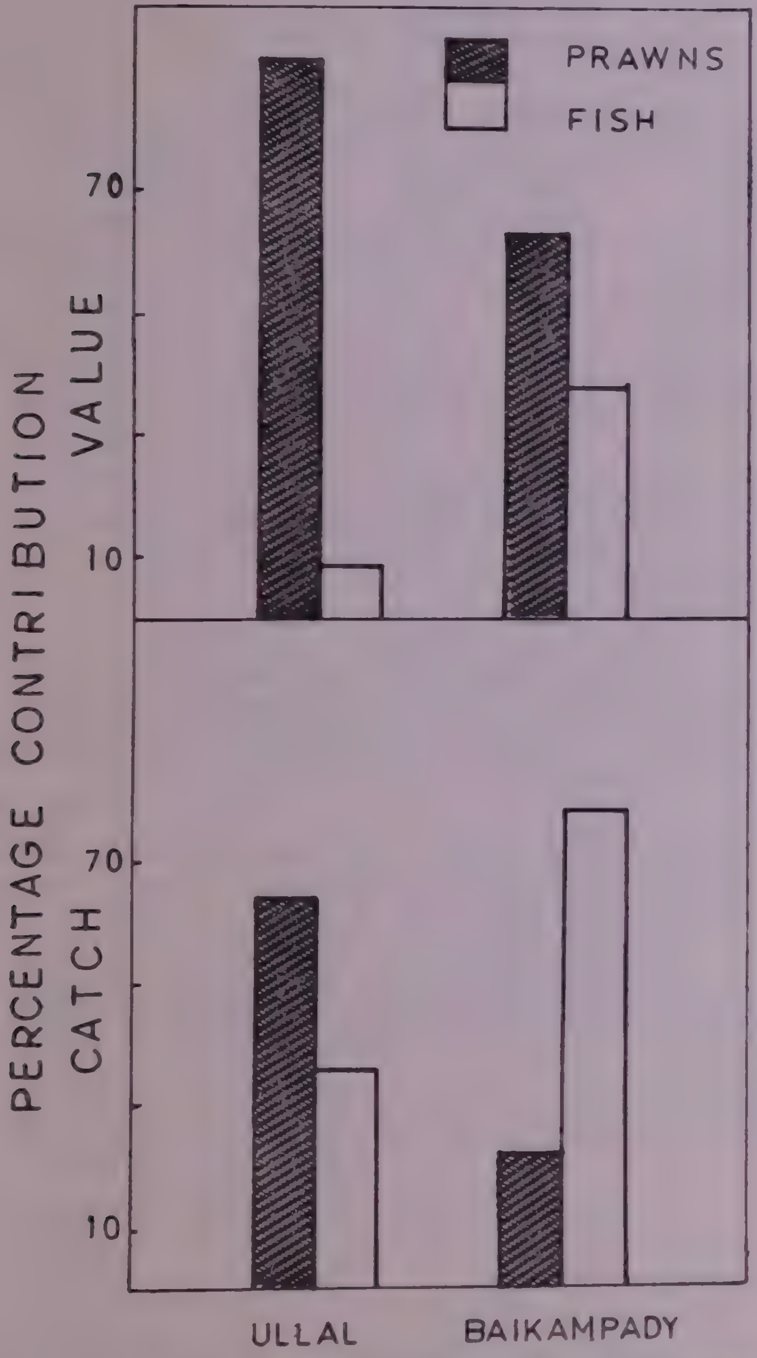

Fig. 3. Percentage contribution of prawns and fishes in 'matabala' catch at Ullal and Baikampady in respect of catch and value during July – August, 1986.

The prawns alone formed 63.5% of the 'matabala' catch at this centre (Fig. 3). Among the species, *Metapenaeus dobsoni* contributed 96.8% of the prawn landings, while *Penaeus indicus* and *Parapenaeopsis stylifera* together formed the rest (Table 1).

In the 'matabala' catch, fishes formed 36.5% at this centre. Bulk of the catch was obtained in July '86. The important species were *Thryssa* sp., silver bellies, *Kowala koval,* mackerel, *Caranx* sp., *Ambassis* sp., *Lactarius lactarius* and anchovies. It is interesting to note that oil sardine which used to be a major component in the traditional gears in the monsoon season, was completely absent during the 1986 season*.

Baikampady (Panambur Harbour): The prawn catch amounted to 6.0 t with a catch rate per boat-day of 27.3 kg during this period. All the catch was obtained in July 1986 itself. Prawns formed only 22.1% of the 'matabala' catch at this centre (Fig. 2). *M. dobsoni* was the principal species contributing to 95.0% of the prawn landings, and *P. indicus* formed the rest (Table 1).

Fishes contributed 77.9% of the catch. Silver bellies, *Lactarius lactarius, Ambassis* spp., *Kowala koval,* carangids, anchovies, soles and mackerel were the major components in the fish catch. Like Ullal,

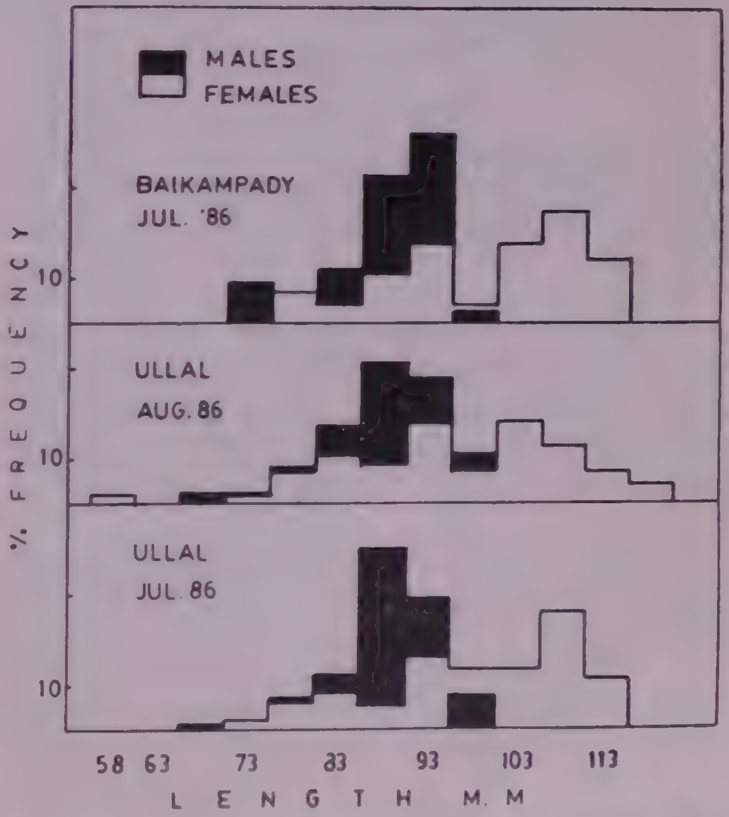

Fig. 4. Size distribution of *M. dobsoni* in the 'matabala' catch at Ullal and Baikampady during July – August 1986.

Table 1. *Catch (kg) and effort (nos.) at Ullal and Baikampady during July - August 1986 (catch values in Rupees in respect of prawns are given in parentheses)*

	ULLAL			BAIKAMPADY
	July	August	Total	July
'Matabala' units	214	74	288	220
M. dobsoni	1,04,840 (17,29,860)	2,273 (37,505)	1,07,113 (17,67,365)	5,714 (94,281)
P. indicus	3,447 (1,75,797)	48 (2,448)	3,495 (1,78,245)	300 (15,300)
P. stylifera	30 (480)	19 (304)	49 (784)	—
Total prawns	1,08,317 (19,06,137)	2,340 (40,257)	1,10,657 (19,46,394)	6,014 1,09,581

Table 2. *Prawn landings by 'matabala' (in kg) along with the catch value in Rupees at other centres during Jul. - Aug.* 1986

Month	POLIPPU		UCHILA		HEJAMADI		MALPE	
	Catch	Value	Catch	Value	Catch	Value	Catch	Value
July	11,040	1,91,826	29,120	4,98,450	29,961	6,29,188	32,626	6,64,324
August	6,896	1,62,824	15,584	26,694	—	—	—	—
Total	17,936	3,54,650	44,704	7,65,392	29,961	6,29,188	32,626	6,64,324

there was no oil sardine in the catches at Baikampady during this period*.

'Matabala' prawn landings at other centres

Uchila: The prawn catch amounted to 44.7 t with a catch rate per boat-day of 827.8 kg. Of this, 65.1 kg was caught in July and the rest in August '86 (Table 2). *M. dobsoni* contributed 100% of the prawn catch.

Polippu: It is estimated that 17.9 t of the prawns with a catch per boat-day of 498.1 kg was landed at this centre (Table 2). Out of this, 61.5% was landed in July and the rest in August '86. *M. dobsoni* formed 92.1% and the rest by *P. indicus.*

Hejamadi: The prawn catch amounted to 30.0 t (Table 2). *M. dobsoni* formed 100% of the prawn landings.

Malpe: About 33.0 t of prawns with a catch per boat-day of 1,359.4 kg were landed at this centre (Table 2). All the catches were obtained in July '86. *M. dobsoni* formed 100% of the prawn catch.

Catch value

Altogether around 242.0 t of prawns were landed between Ullal in the south and Malpe in the north by 'matabala' during this season, worth Rs. 4.4 millions (Tables 1 and 2).

At Ullal, the catch value was estimated at Rs. 2.14 million of which prawns alone contributed 91.0% and the rest by fishes (Fig. 3).

At Baikampady, Rs. 0.17 million was realised, of which 63.3% was obtained through the sale of prawns (Fig. 3).

Size composition of *M. dobsoni*

It is interesting to note that the fishery was mainly supported by large sized prawns. In the 'matabala' fishery at Ullal, this species was represented by sizes ranging from 68 to 98 mm (mode at 88 mm) in males, and from 58 to 118 mm (mode at 93 and 108 mm in July '86 and 98 and 108 mm in August '86) in females (Fig. 4).

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*However, during the 1987 season, oil sardine was caught in small quantities in this gear at both the centres. Other indigenous gears did not operate.

Table 3. *Age structure (%) in respect of* M. dobsoni *at Ullal and Baikampady during July - August*, 1986

Age	ULLAL				BAIKAMPADY	
	July		August		July	
	Males	Females	Males	Females	Males	Females
0-year	3.1	21.7	3.7	32.7	2.7	21.6
1-year	96.9	78.3	96.3	66.3	97.7	78.4

Table 4. *Sex ratio (%) in* M. dobsoni *at Ullal and Baikampady during July - August*, 1986

Month	ULLAL		BAIKAMPADY	
	Males	Females	Males	Females
July	61.5	38.5	54.1	45.9
August	49.5	50.5	—	—

Table 5. *Maturity stages of* M. dobsoni *at Ullal and Baikampady during July - August*, 1986

Place	Month	Immature	Maturing	Mature	Spent/spent recovering	Impregnated
Ullal	July	45.2	16.1	32.2	6.5	17.7
	August	61.8	9.1	10.8	16.4	18.2
Baikampady	July	32.1	35.8	32.1	—	14.3

At Baikampady, prawns ranging in size from 73 to 98 mm (mode at 93 mm) in males and from 78 to 113 mm (mode at 93 and 108 mm) in females supported the fishery (Fig. 4).

Age structure

Among males, 0-year class formed only 3–4 % at Ullal and about 2% at Baikampady, whereas, 1-year group (above 80 mm size) contributed the bulk of the catch (96–97% at Ullal and 98% at Baikampady). Among females, 22-33% was in O-year class at Ullal and 22% at Baikampady, while 1-year class (above 95 mm size) formed 66–78% at the former centre and 78% at the latter.

Sex ratio and maturity

The overall sex ratio in *M. dobsoni* indicated that males outnumbered females at both centres. In July '86, males formed 61.5% and 54.1% at Ullal and Baikampady respectively (Table 4). However, in August '86, it was seen that males and females were distributed more or less equally.

During 1986 season, 32.2% and 32.1% of females were in mature condition at Ullal and Baikampady respectively (Table 5). Impregnated females formed 17.7% and 14.3% respectively at these centres. In August '86, 18.2% of females was in impregnated condition at Ullal. The occurrence of spent/spent recovering females at Ullal (6.5% in July and 16.4% in August '86) suggested peak spawning particularly in the latter month.

General remarks

Exceptionally heavy catches of *M. dobsoni* were obtained in 'matabala' on certain days in July and August '86 (Fig. 2). This species alone contributed upto 98% or even 100% of the prawn landings. It is estimated that around 242 t of prawns landed between Ullal and Malpe, within a range of 70 km, in a short period. Questions have been raised at various forums whether catching of these prawns at a time when peak spawning recorded, has any adverse effect on the resource. It is seen that monsoon fishery is exclusively supported by large sized prawns with modal lengths at 88 mm in males and 103/108 mm in females. Since most of these prawns have already spawned 2–3 times and also reached their maximum size, it is desirable to catch them during that period, instead of leaving them to breed again (Sukumaran, 1985; *Mar. Fish. Infor. Serv., T & E Ser.*, **65**: 1-6). Moreover, these prawns with such a short life span (with maximum of 2 years) are available to the fishery for not more than a year or so. Hence it is possible that they may die of natural mortality if not caught at that size, which may be a heavy loss to the fishery. Although the catches are heavy on certain days in July '86, the total landings of *M. dobsoni* was only 106 t at Ullal and less than 250 t along the entire Mangalore coast and hence may not pose any conservatory problem in the near future.

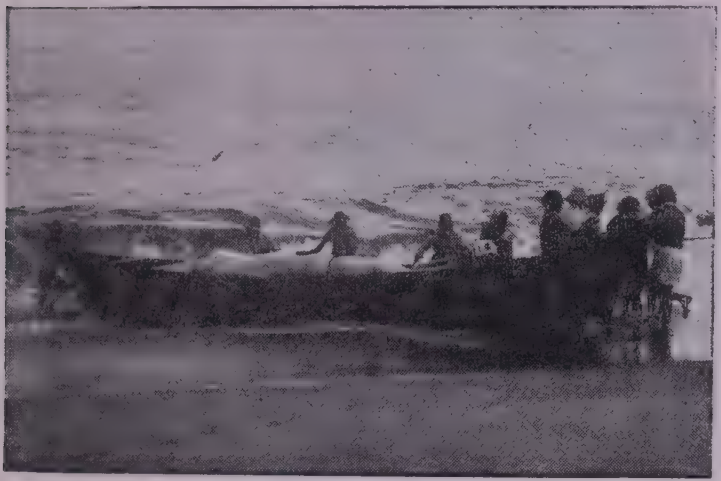

Fig. 5 'Matabala' unit is being landed after fishing at Ullal.

Eventhough the introduction of 'matabala' along the Mangalore coast has revolutionised the monsoon fishery, it has also created unprecedented rivalry between fishermen of 'matabala' and the mechanised fishing boats. In the last two seasons since mechanised boats, particularly purse seiners, could not get any prawn catch when fishing started in September, they decided to start fishing in August itself as 'matabala' was getting plenty of prawns during July–August '86.

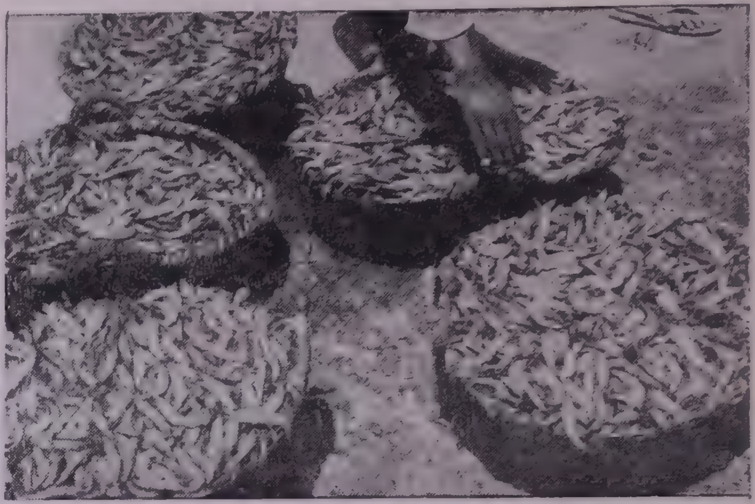

Fig. 6. Prawns are being filled in bamboo baskets for weighing before loading in to the trucks at Ullal.

It was reported in the news paper that fishing was banned along this coast till 22nd August following a clash on 17th August '86 between the traditional fishermen and those using mechanised fishing boats. In these clashes four boats were set on fire and 28 fishermen were injured at the sea off Hejamadi, about 30 km north of Mangalore. The loss was estimated to be Rs. 35 lakhs. Trouble started when the fishermen took the mechanised fishing boats to the sea despite the understanding that no fishing would be undertaken till 22nd August '86. Emotional traditional fishermen joined together in their country boats and chased the fishing boats and set them on fire. All efforts to bring the two fighting factions to a negotiating table met with little success. Due to this, ban on fishing was further extended till the end of August 1986.

So, unless a permanent solution is found, the rivalry between 'matabala' fishermen and other mechanised boat owners may lead to further clashes resulting in loss of life and property.

PRELIMINARY OBSERVATIONS ON THE EFFICIENCY OF SOME MICROALGAL FOODS ON THE GROWTH OF GREEN MUSSEL LARVAE*

For the mass production of seed of bivalves in hatchery system, production, maintenance and supply of suitable microalgal food are important part of the operation. A knowledge about the efficiency of different algal species on the growth of the bivalve larvae will be helpful in developing suitable food for achieving faster growth, early spat settlement, higher percentage of survival and healthy individuals. An attempt was made in this direction on the larvae of the green mussel *Perna viridis* (Linnaeus) at the Kovalam Field laboratory of Madras Research Centre of Central Marine Fisheries Research Institute.

The larvae of the green mussel, reared from the spawning on 18th July, 1987 in laboratory were utilised for conducting the experiment. Four sets of larvae were maintained in duplicate in the laboratory, feeding them separately with pure cultures of *Isochrysis* sp., *Chromulina* sp., *Dicrateria* sp. and *Pavlova* sp. Though spat settlement was completed in 24 days, growth data was maintained till 35th day. Water temperature ranged between 26.9 and 27.6°C and salinity between 36.6 and 37.8‰ during the period. The cell concentration of the microalgal food was maintained uniformly for all the sets of larvae at the rate of 3,000 cells/larva initially and was raised gradually to 6,000 cells at later stages.

The details regarding the initial stocking density, water level maintained, total number of spat settled and the percentage in the initial strength of the larvae are given in Table 1. Of the four algal species experimented with, maximum settlement was noticed for the larvae fed with *Isochrysis* sp. followed by *Dicrateria* sp. and *Chromulina* sp. and the minimum with *Pavlova* sp. However, when the growth and progress of metamorphosis were considered (Table 2), *Chromulina* sp. and *Dicrateria* sp. were observed to give better results than the other two species. Therefore, it is suggested that *Dicrateria* sp. and *Chromulina* sp. can be utilised as the microalgal food in the green mussel hatchery to get better results.

Table 1. *Details of larvae stocked, volume of water maintained, number of spats settled and their percentage with different microalgal food*

Microalgal food	Total larvae stocked	Volume of water maintained (l)	No. of spat settled (as on 24th day)	Density of spat settled (%)
Isochrysis sp.	1,98,000	150	23,000	11.6
Chromulina sp.	80,000	80	6,700	8.4
Dicrateria sp.	92,000	80	9,000	9.8
Pavlova sp.	40,000	40	2,200	5.5

Table 2. *Length and stages of development of green mussel larvae fed with different microalgal food*

Day after Spawning	Mean length (mm)				Stages of metamorphosis			
	Isochrysis	*Chromulina*	*Dicrateria*	*Pavlova*	*Isochrysis*	*Chromulina*	*Dicrateria*	*Pavlova*
5th	0.090	0.090	0.090	0.090	D-shaped	D-shaped	D-shaped	D-shaped
9th	0.141	0.136	0.133	0.136	D & umbo	D & umbo	D & umbo	D & umbo
12th	0.190	0.268	0.264	0.182	Umbo & eyed	Eyed	Eyed	Umbo
16th	0.210	0.362	0.378	0.246	Umbo, eyed & spat	Eyed & spat	Eyed & spat	Umbo, eyed & spat
20th	0.328	0.520	0.544	0.352	Eyed & spat	Spat	Spat	Eyed & spat
24th	0.692	0.792	0.880	0.828	Spat	Spat	Spat	Spat
30th	1.293	1.701	1.314	1.322	Spat	Spat	Spat	Spat
35th	1.765	2.508	2.209	2.101	Spat	Spat	Spat	Spat

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*Prepared by P. V. Sreenivasan, K. Satyanarayana Rao, P. Poovannan and R. Thangavelu, Madras Research Centre of CMFRI, Madras.

* * *

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8/9/89

No. 83
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Abbreviation – *Mar. Fish. Infor. Serv., T & E Ser.*, No. **83**: 1988

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Front cover photo:

The newly–constructed fisheries harbour complex at Kakinada.

Back cover photo:

The present trawler landing centre in Upputeru canal at Kakinada.

MARINE FISH CALENDAR

V. KAKINADA*

V. Sriramachandra Murty, M. K. Bandyopadhyay and P. Ramalingam

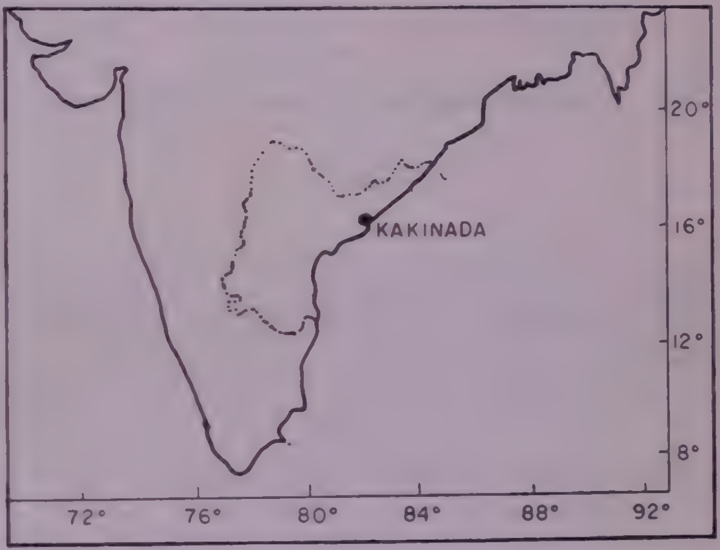
Kakinada Research Centre of CMFRI, Kakinada

Introduction

The Research Centre of the Central Marine Fisheries Research Institute at Kakinada has been carrying out investigations on various exploited marine fisheries resources of the region. As a part of these investigations, data on effort and catches of different groups of fishes have been collected from important landing centres. Commercial trawling off Kakinada was started in 1964 and since then, monitoring of catches has been carried out on a regular basis and the details of effort and catches of different groups during the period 1969–'78 were published *(Mar. Fish. Infor. Serv., T & E Ser., No.* 31, 1981). The mechanised boats use shrimp trawl with a cod end mesh size of 15–20 mm and there is fishing round the year.

Data of the period 1981–'85 from the trawlers and 1980–'82 from indigenous gear and published information on different species from Kakinada are used for the present fish calendar. Data on effort and catch from each gear separately, of the corresponding months are pooled and the catch per unit (boat/gear) effort for each month calculated. The data are analysed separately for trawl catch from Kakinada and gill net catch from Uppada. The data of shore seine, boat seine and drag net from Uppada are pooled and considered under the head "other units".

Since a great majority of fish families are represented by several species, data on catches are collected family-wise. In the case of dominant families, however, detailed data on species composition and biology of dominant species are available. In such cases information pertaining to different species is provided in the Calendar. In case where imformation on species is not available, group-wise data under respective families are given. In certain cases family-wise data are not available and in these cases information on 2–3 closely related families are given together.



Carangidae

Popular English Name : Scad/Horse mackerel/ Trevallies

Vernacular Name (Telegu) : 'Paralu'/'Pilladugulu'

Annual average catch : 1,779 t

Percentage in total catch : 13.8

Fishing methods and their contribution : Trawl net : 10.2%

Gill net : 3.5%

Other units : 5.5%

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*Consolidated by N. Gopinatha Menon and K. Balachandran, CMFRI, Cochin.

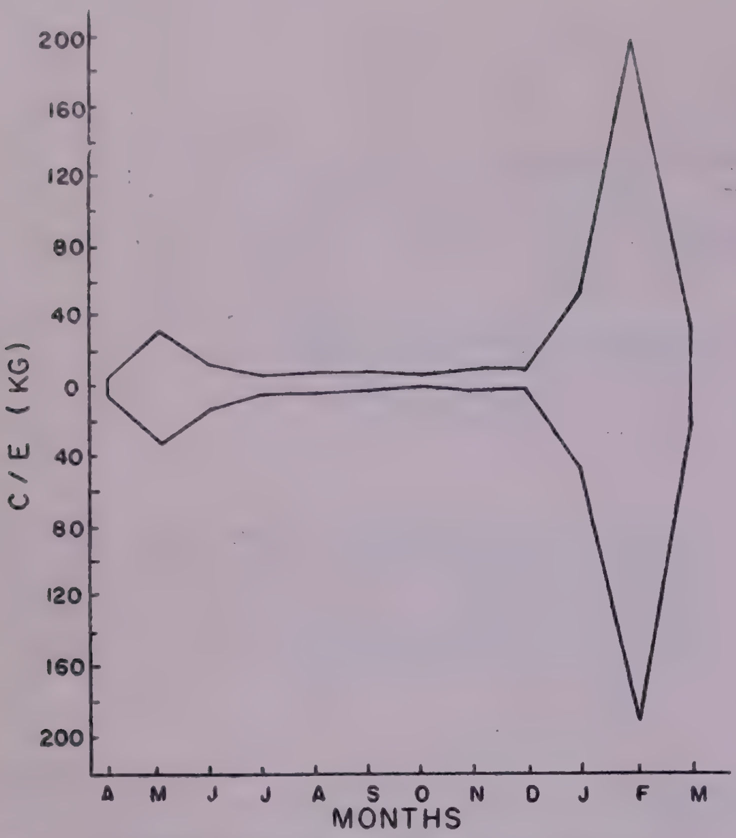


Fig. 1. Seasonal abundance of carangids in trawl catch.

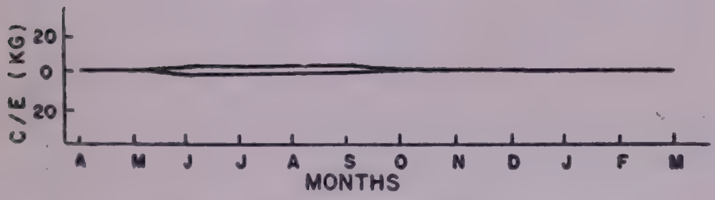


Fig. 2. Seasonal abundance of carangids in gill net catch.

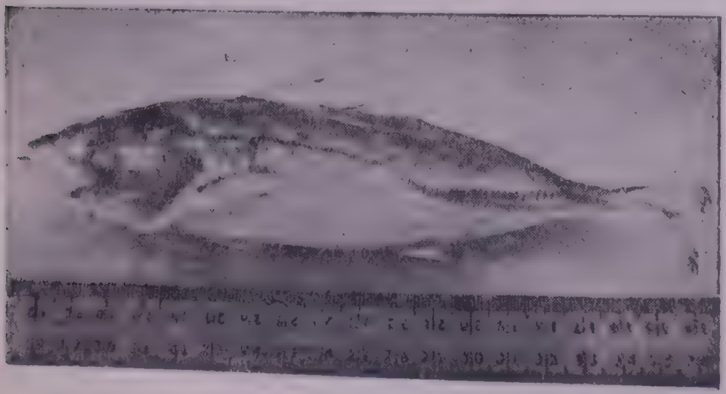


Fig. 3. *Decapterus russelli.*

Scientific Name : *Decapterus russelli*
Vernacular Name : 'Pilladugulu'
Gear : Trawl net
Percentage in the catch of the group : 83.0
Peak period of occurrence : Jan. - Apr.
Depth of occurrence : 10 – 80 m
Length range in commercial fishery : 52 – 217 mm
Size at first maturity : 150 mm
Spawning season : Dec. – Jun.

CARCHARHINIDAE

Popular English Name : Sharks
Vernacular Name (Telugu) : 'Sorralu'
Annual average catch : 253 t
Percentage in total catch : 2.0
Fishing methods and their contribution : Gill net : 13.2%
Trawl net : 0.3%
Peak period of occurrence : Feb. – May and Oct. – Nov.
Depth of occurrence : 5 – 50 m

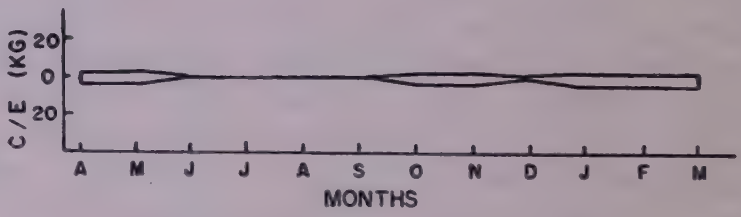


Fig. 4. Seasonal abundance of sharks in trawl catch.

CHIROCENTRIDAE

Popular English Name : Wolf herring
Vernacular Name (Telugu) : 'Mulluvala'
Annual average catch : 54 t
Percentage in total catch : 0.4
Fishing methods and their contribution : Gill net : 3.6%
Peak period of occurrence : Jul. – Sep.
Depth of occurrence : 3 – 70 m

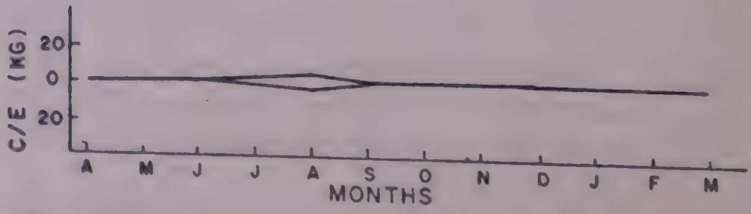


Fig. 5. Seasonal abundance of wolf herrings in gill net catch.

CLUPEIDAE

Popular English Name : Sardines/Lesser sardines/ Shad
Vernacular Name (Telugu) : 'Kavallu'
Annual average catch : 462 t
Percentage in total catch : 3.6
Fishing methods and their contribution : Gill net : 11.5%
Trawl net : 1.6%
Other gears : 4.0%
Peak period of occurrence : Jan. – Nov.
Depth of occurrence : 1 – 60 m

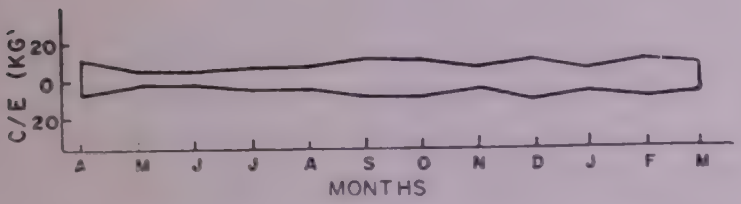


Fig. 6. Seasonal abundance of *Thryssa* in trawl catch.

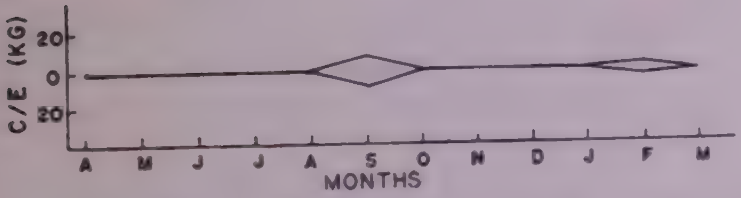


Fig. 7. Seasonal abundance of *Thryssa* in other units.

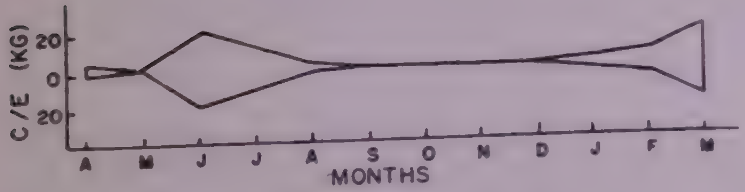


Fig. 8. Seasona abundance of lesser sardines in trawl catch.

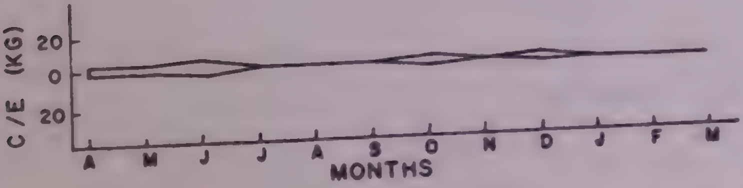


Fig. 9. Seasonal abundance of lesser sardines in gill net catch.]

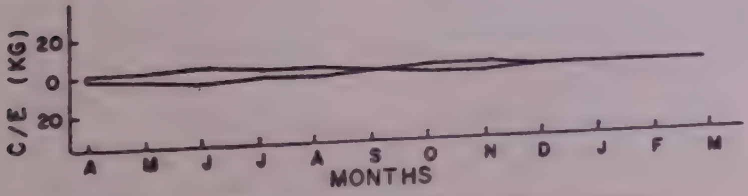


Fig. 10. Seasonal abundance of shads in gill net catch.

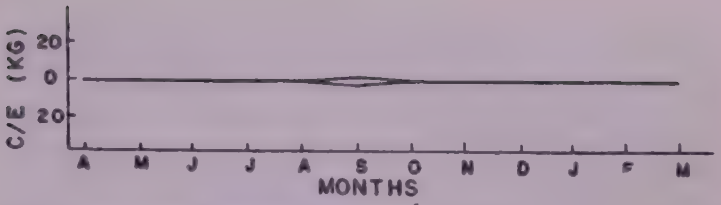


Fig. 11. Seasonal abundance of other clupieds in gill net catch.

CYNOGLOSSIDAE, SOLEIDAE, PSETTODIDAE AND BOTHIDAE

Popular English Name : Flat fish
Vernacular Name (Telugu) : 'Tamnaratta'
Annual average catch : 318 t
Percentage in total catch : 2.5
Fishing methods and their contribution : Trawl net : 1.9%
Peak period of occurrence : Dec. – May
Depth of occurrence : 5 – 50 m

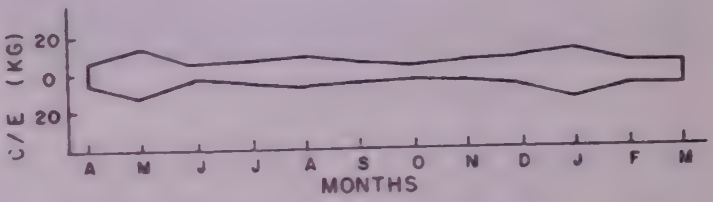


Fig. 12. Seasonal abundance of flat fishes in trawl catch.

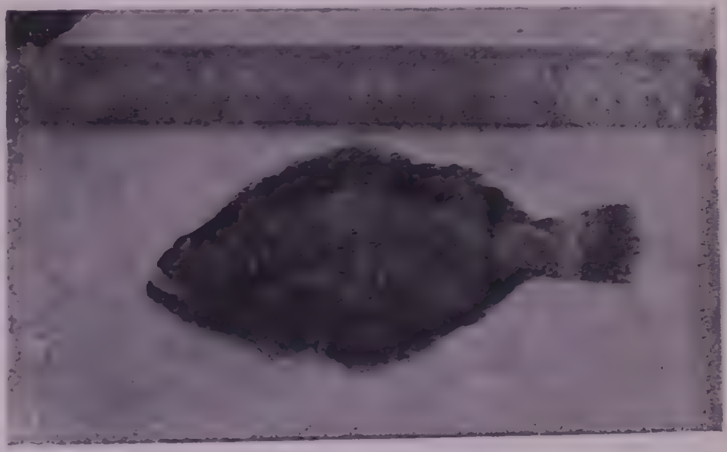


Fig. 13. *Psettodes erumei.*

Scientific Name : *Psettodes erumei*
Vernacular Name : 'Yeddunalika'
Gear : Trawl net
Percentage in the catch of the group : 100
Peak period of occurrence : Dec. - Feb.
Depth of occurrence : 5 - 50 m
Length range in commercial fishery : —
Size at first maturity : —
Spawning season : —

DUSSUMIERIDAE

Popular English Name : Rainbow sardine
Vernacular Name (Telugu) : 'Moravalu'
Annual average catch : 20 t
Percentage in total catch : 0.1
Fishing methods and their contribution : Gill net : 1.1%
Other units : 0.9%

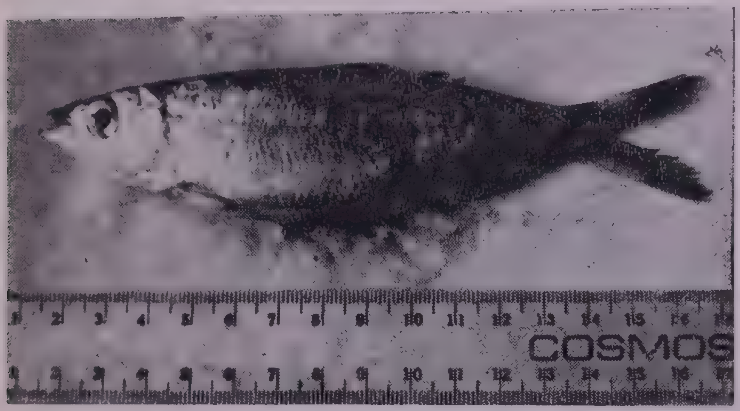


Fig. 14. *Dussumieria acuta.*

Scientific Name : *Dussumieria acuta*
Vernacular Name : 'Moravalu'
Gear : Gill net/Other units
Percentage in the catch of the group : 100
Peak period of occurrence : Oct. – Dec.
Depth of occurrence : Upto 50 m
Length range in commercial fishery : —
Size at first maturity : —
Spawning season : —

ENGRAULIDAE

Popular English Name : White bait/Anchovies
Vernacular Name (Telugu) : 'Nettallu'/"Poravalu'
Annual average catch : 1,104 t
Percentage in total catch : 8.6
Fishing methods and their contribution : Trawl net : 6.1%
Gill net : 2.0%
Other units : 12.5%

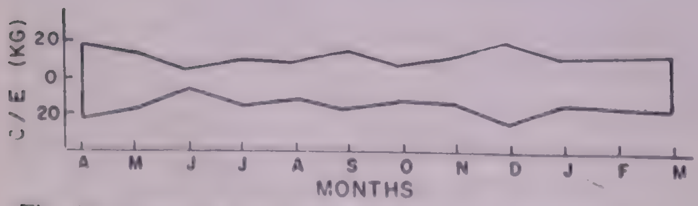


Fig. 15. Seasonal abundance of white bait in trawl catch.

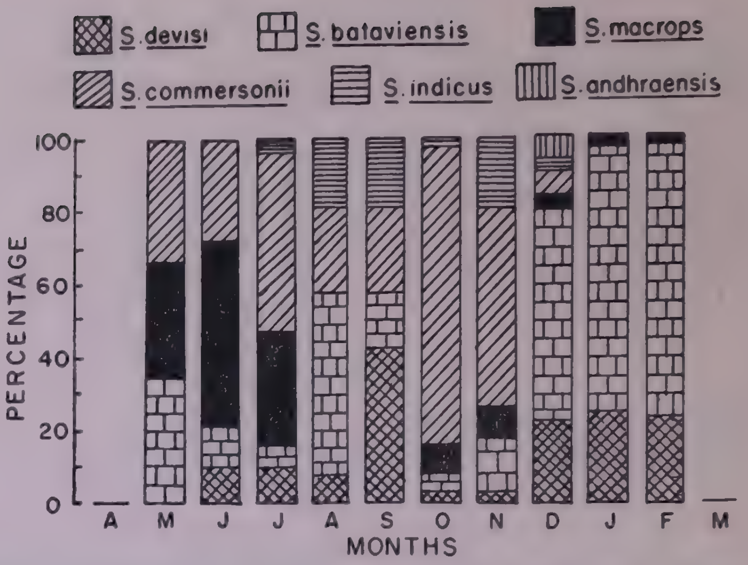


Fig. 16. Monthwise species composition of white bait in trawl catch.

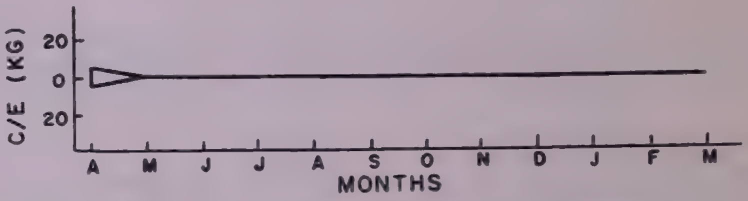


Fig. 17. Seasonal abundance of white bait in other units.

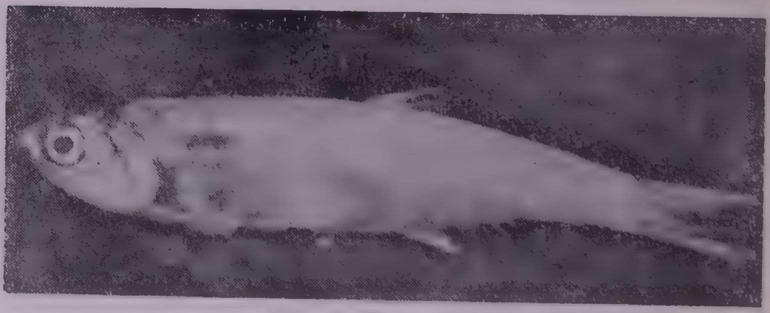


Fig. 18. *Stolephorus bataviensis.*

Scientific Name : *Stolephorus bataviensis*
Vernacular Name : 'Nettallu'
Gear : Trawl net/Gill net/Other units
Percentage in the catch of the group : 41.1
Peak period of occurrence : Jan.–May and Jul. –Sep.
Depth of occurrence : Upto 50 m
Length range in commercial fishery : 40 – 109 mm
Size at first maturity : —
Spawning season : —

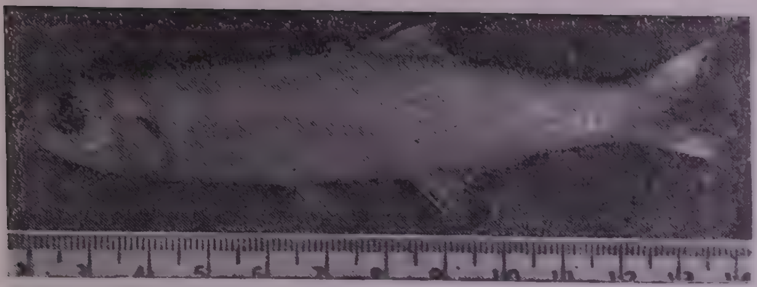


Fig. 19. *Stolephorus commersonii.*

Scientific Name : *Stolephorus commersonii*
Vernacular Name : 'Nettallu'
Gear : Trawl net/Gill net/ Other units
Percentage in the catch of the group : 23.4
Peak period of occurrence : Jan.–May and Jul.–Sep.
Depth of occurrence : Upto 50 m
Length range in commercial fishery : 70 – 139 mm
Size at first maturity : —
Spawning season : —

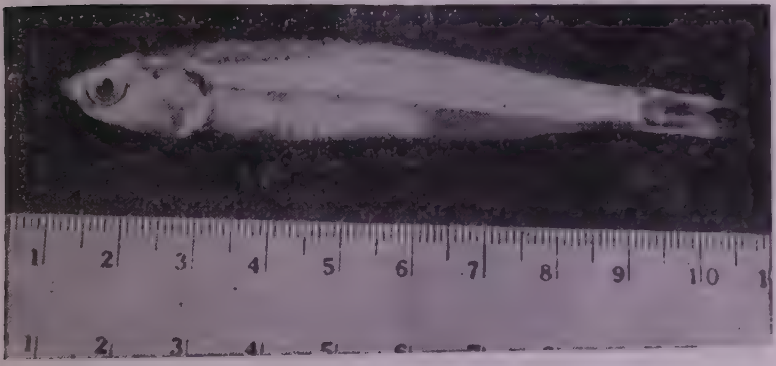


Fig. 20. *Stolephorus devisi.*

Scientific Name : *Stolephorus devisi*
Vernacular Name : 'Nettallu'
Gear : Trawl net/Gill net/ Other units
Percentage in the catch of the group : 15.9
Peak period of occurrence : Jan.–May and Jul.–Sep.
Depth of occurrence : Upto 50 m
Length range in commercial fishery : 55 – 94 mm
Size at first maturity : —
Spawning season : —

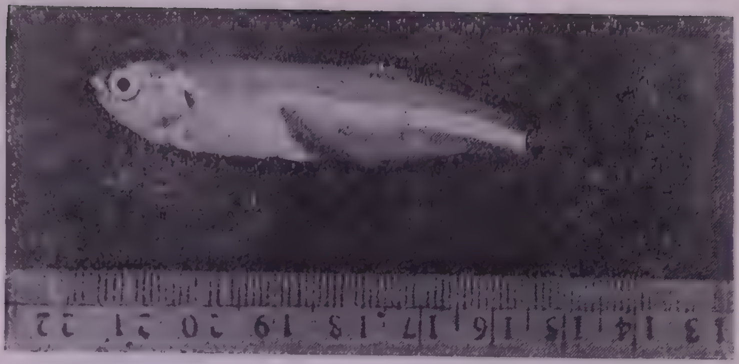


Fig. 21. *Stolephorus macrops.*

Scientific Name : *Stolephorus macrops*
Vernacular Name : 'Nettallu'
Gear : Trawl net/Gill net/ Other units
Percentage in the catch of the group : 15.0
Peak period of occurrence : Jan.–May and Jul.–Sep.
Depth of occurrence : Upto 50 m
Length range in commercial fishery : 50 – 100 mm
Size at first maturity : —
Spawning season . —

HARPODONTIDAE

Popular English Name : Bombay duck
Vernacular Name (Telugu) : 'Vanamattalu'
Annual average catch : 155 t
Percentage in total catch : 1.2
Fishing methods and their contribution : Trawl net : 0.9%
Gill net : 0.4%
Other units : 0.3%

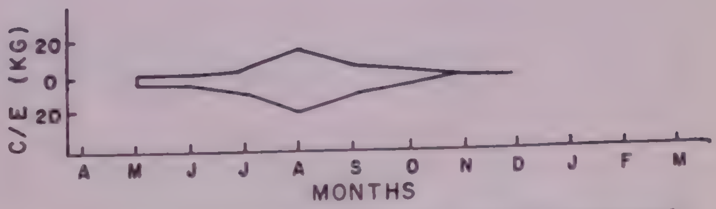


Fig. 22. Seasonal abundance of Bombay duck in trawl catch.

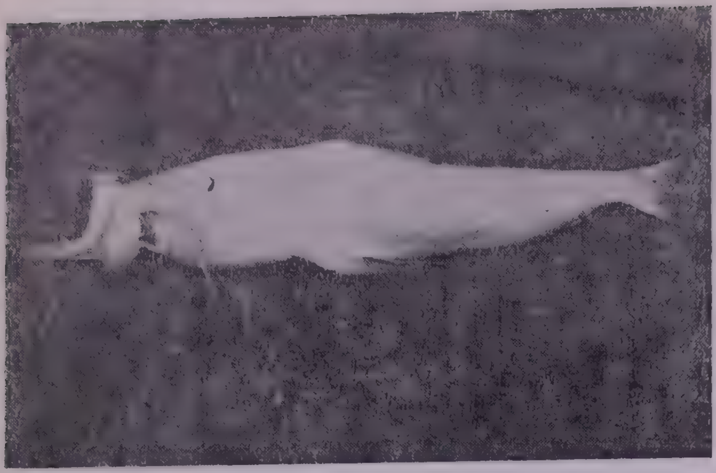


Fig. 23. *Harpodon nehereus.*

Scientific Name : *Harpodon nehereus*
Vernacular Name : 'Vanamattalu'
Gear : Trawl net/Gill net/Other units
Percentage in the catch of the group : 100
Peak period of occurrence : May – Oct.
Depth of occurrence : Upto 60 m
Length range in commercial fishery : 170 – 300 mm
Size at first maturity : —
Spawning season : —

LACTARIDAE

Popular English Name : White fish
Vernacular Name (Telugu) : 'Sudumulu'
Annual average catch : 85 t
Percentage in total catch : 0.7
Fishing methods and their contribution : Trawl net : 0.5%

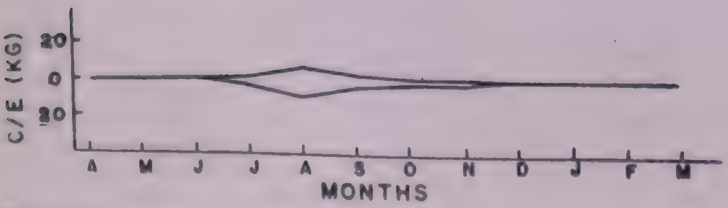


Fig. 24. Seasonal abundance of *Lactarius* in trawl catch.

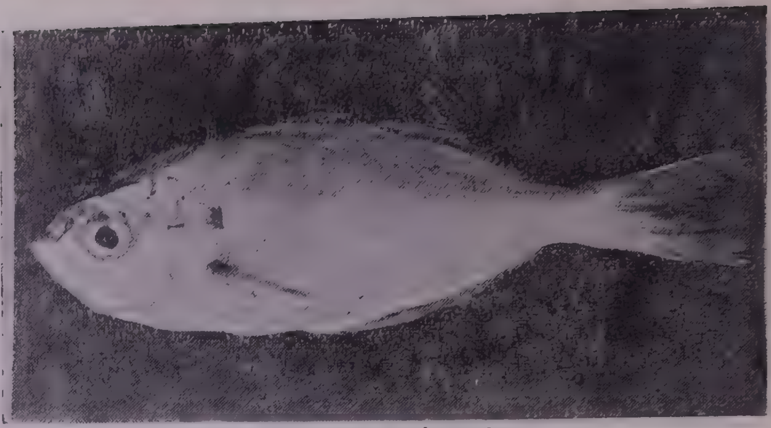


Fig. 25. *Lactarius lactarius.*

Scientific Name : *Lactarius lactarius*
Vernacular Name : 'Sudumulu'
Gear : Trawl net
Percentage in the catch of the group : 100
Peak period of occurrence : Jul. – Sep.
Depth of occurrence : 5 - 50 m
Length range in commercial fishery : —
Size at first maturity : —
Spawning season : —

LEIOGNATHIDAE

Popular English Name : Silver bellies/Pony fish
Vernacular Name (Telugu) : 'Karalu'
Annual average catch : 1,347 t
Percentage in total catch : 10.5
Fishing methods and their contribution : Trawl net : 7.9%
Other units : 6.7%

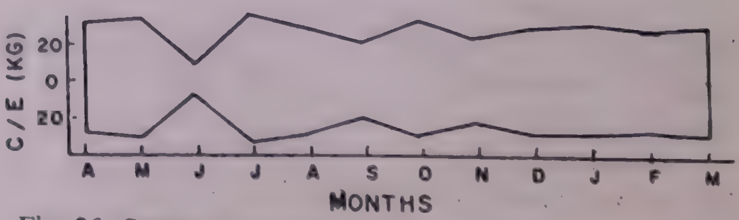


Fig. 26. Seasonal abundance of silver bellies in trawl catch.

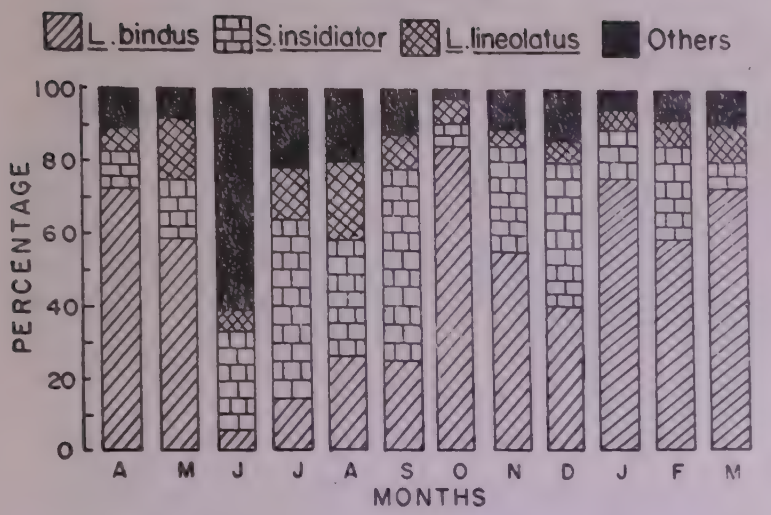


Fig. 27. Monthwise species composition of silver bellies in trawl net.

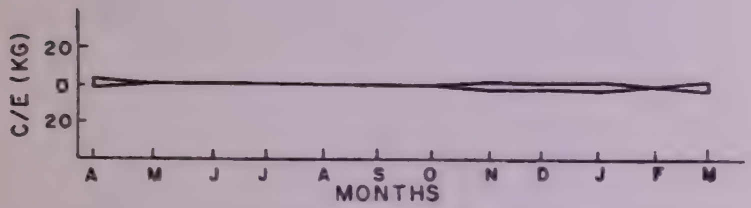


Fig. 28. Seasonal abundance of silver bellies in gill net catch.

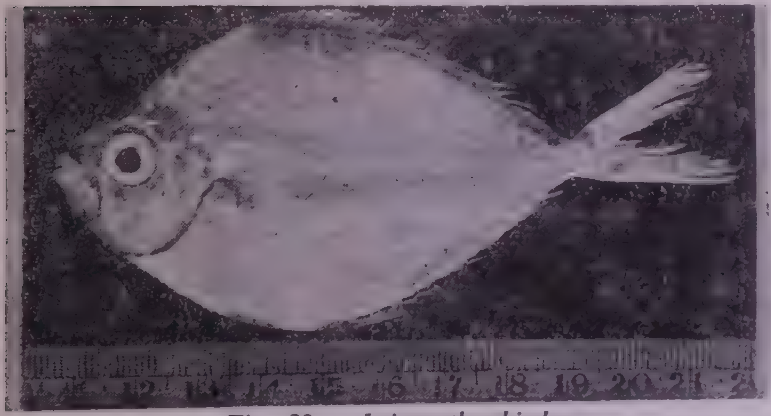


Fig. 29. *Leiognathus bindus.*

Scientific Name : *Leiognathus bindus*
Vernacular Name : 'Karalu'
Gear : Trawl net/Other units
Percentage in the catch of the group : 45.2
Peak period of occurrence : Jan.-May and Oct.-Dec.
Depth of occurrence : 5 – 50 m
Length range in commercial fishery : 17 – 129 mm
Size at first maturity : 80 mm
Spawning season : Dec. – Feb.

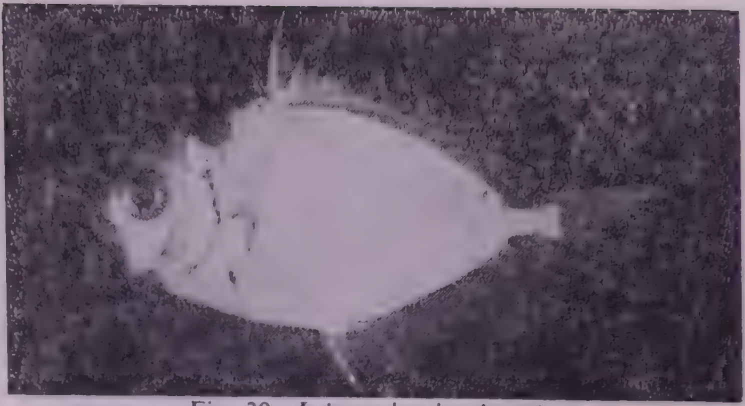


Fig. 30. *Leiognathus brevirostris.*

Scientific Name : *Leiognathus brevirostris*
Vernacular Name : 'Karalu'
Gear : Trawl net/Other units
Percentage in the catch of the group : 4.4
Peak period of occurrence : Feb., Jun., Jul. and Nov.
Depth of occurrence : 5 – 50 m
Length range in commercial fishery : 60 - 105 mm
Size at first maturity : —
Spawning season : —

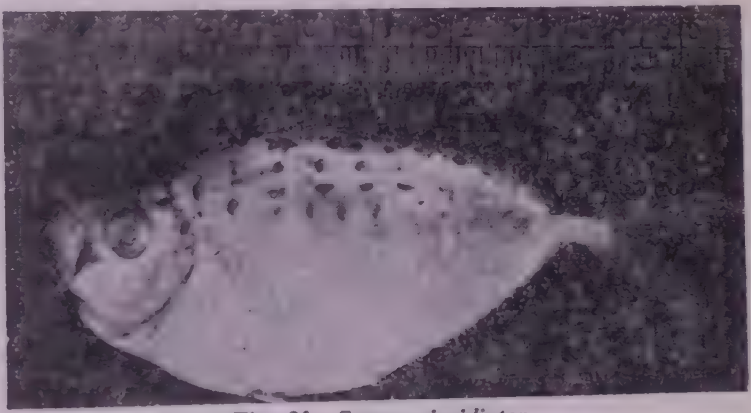


Fig. 31. *Secutor insidiator.*

Scientific Name : *Secutor insidiator*
Vernacular Name : 'Chukka karalu'
Gear : Trawl net/Other units
Percentage in the catch of the group : 30.0
Peak period of occurrence : Jun. – Sep.
Depth of occurrence : 5 – 50 m
Length range in commercial fishery : 20 - 117 mm
Size at first maturity : 90 mm
Spawning season : Jan. – Mar.

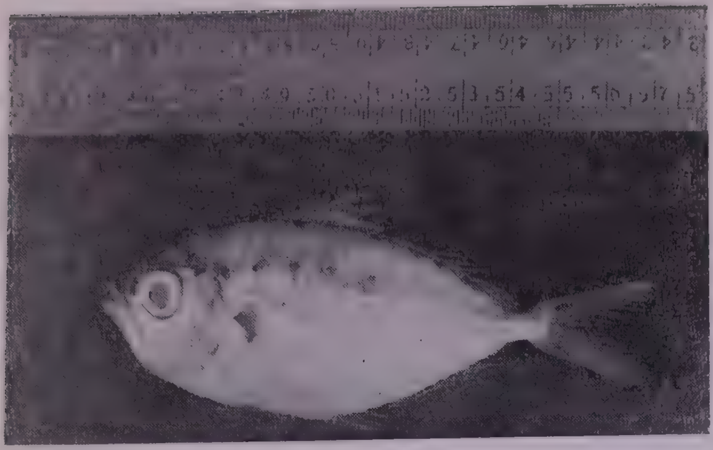


Fig. 32. *Gazza minuta*.

Scientific Name : *Gazza minuta*
Vernacular Name : 'Karalu'
Gear : Trawl net/Other units
Percentage in the catch of the group : 4.7
Peak period of occurrence : May, Aug. and Dec.
Depth of occurrence : 5 – 50 m
Length range in commercial fishery : 62 - 137 mm
Size at first maturity : —
Spawning season : —

LUTJANIDAE, SERRANIDAE AND POMADASYIDAE

Popular English Name : Snappers/Reef cods/ Grunters
Vernacular Name (Telugu) : 'Erragorasa'/ 'Rathibontha'/'Goraka'
Annual average catch : 427 t
Percentage in total catch : 3.3
Fishing methods and their contribution : Trawl net : 2.5%
Peak period of occurrence : Feb., May and Jul.
Depth of occurrence : 5 – 50 m

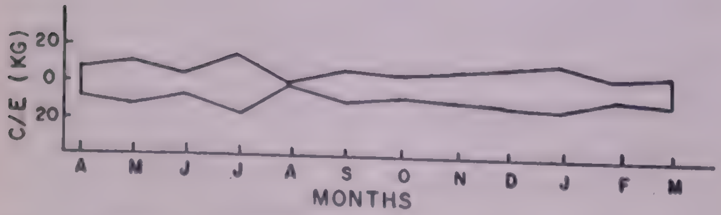


Fig. 33. Seasonal abundance of perches (Lutjanidae, Serranidae *etc.*) in trawl catch.

MULLIDAE

Popular English Name : Goat fish
Vernacular Name (Telugu) : 'Gaddam gulivindalu'
Annual average catch : 200 t
Percentage in total catch : 1.6
Fishing methods and their contribution : Trawl net : 1.2%
Peak period of occurrence : Jul.–Sep. and Nov.–Dec.
Depth of occurrence : 5 – 50 m

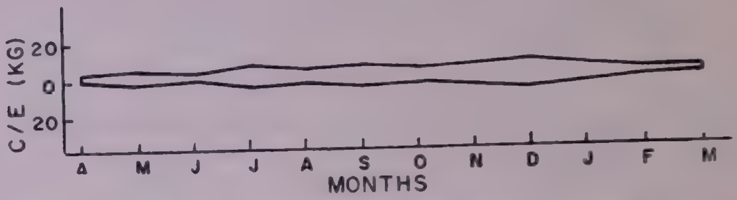


Fig. 34. Seasonal abundance of goat fishes in trawl catch.

MURAENIDAE & CONGRIDAE

Popular English Name : Eel
Vernacular Name (Telugu) : 'Pamulu'
Annual average catch : 249 t
Percentage in total catch : 1.9
Fishing methods and their contribution : Trawl net : 1.5%
Peak period of occurrence : Jul. – Nov.
Depth of occurrence : 5 – 50 m

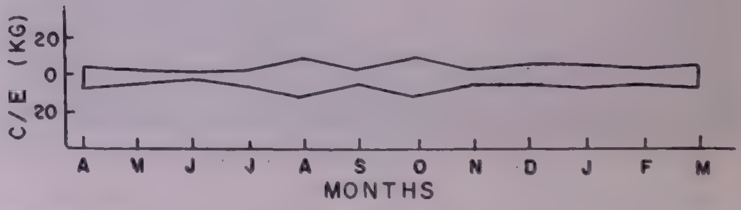


Fig. 35. Seasonal abundance of eel (Muraenidae and Congridae) in trawl catch.

NEMIPTERIDAE

Popular English Name : Threadfin bream
Vernacular Name (Telugu) : 'Erragulivindalu'
Annual average catch : 808 t
Percentage in total catch : 6.3
Fishing methods and their contribution : Trawl net : 4.8%

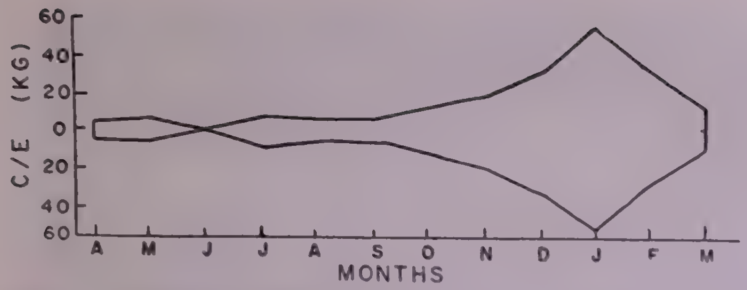


Fig. 36. Seasonal abundance of threadfin breams in trawl catch.

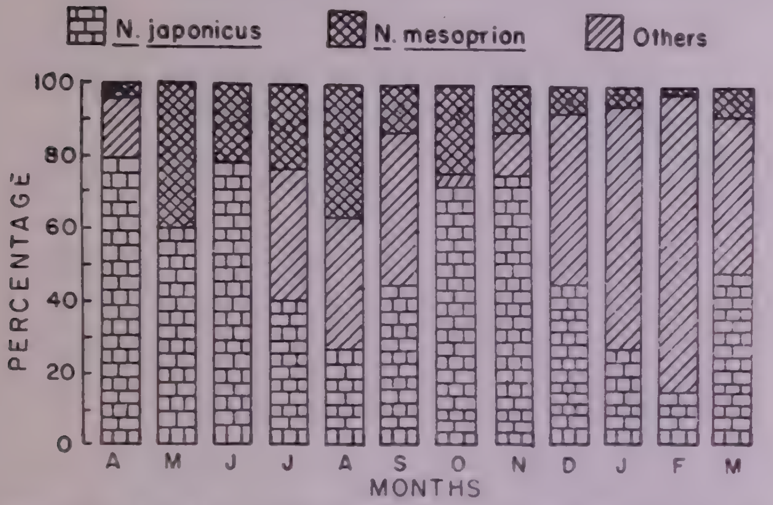


Fig. 37. Monthly species composition of threadfin breams in trawl catch.

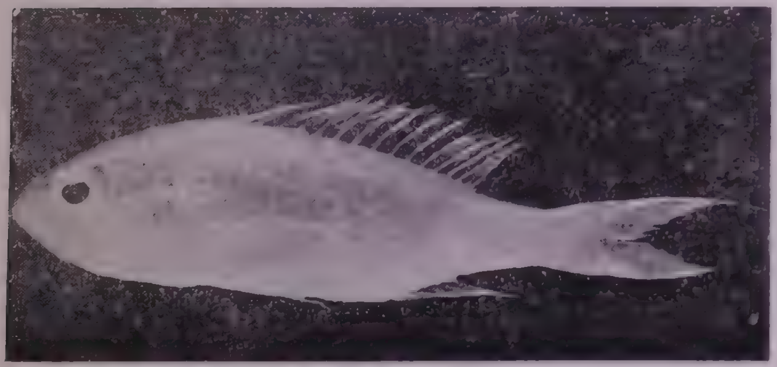


Fig. 38. *Nemipterus mesoprion.*

Scientific Name	:	*Nemipterus mesoprion*
Vernacular Name	:	'Erragulivindalu'
Gear	:	Trawl net
Percentage in the catch of the group	:	48.3
Peak period of occurrence	:	Dec. – Mar.
Depth of occurrence	:	10 - 80 m
Length range in commercial fishery	:	30 – 215 mm
Size at first maturity	:	100 mm
Spawning season	:	Dec. – Apr.

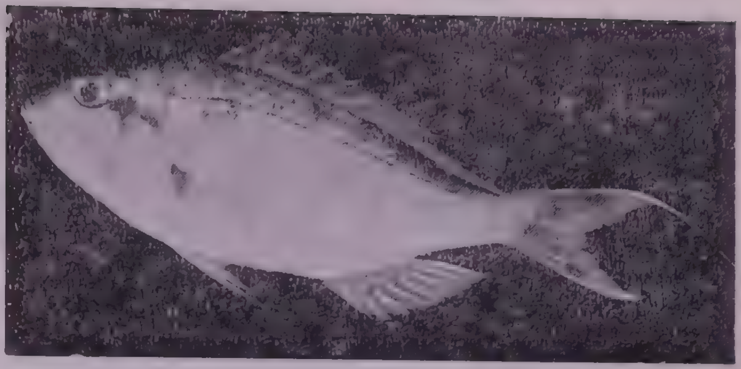


Fig. 39. *Nemipterus japonicus.*

Scientific Name	:	*Nemipterus japonicus*
Vernacular Name	:	'Erragulivindalu'
Gear	:	Trawl net
Percentage in the catch of the group	:	44.4
Peak period of occurrence	:	Nov. – Mar.
Depth of occurrence	:	10 - 80 m
Length range in commercial fishery	:	35 – 305 mm
Size at first maturity	:	125 mm
Spawning season	:	Aug. - Apr.

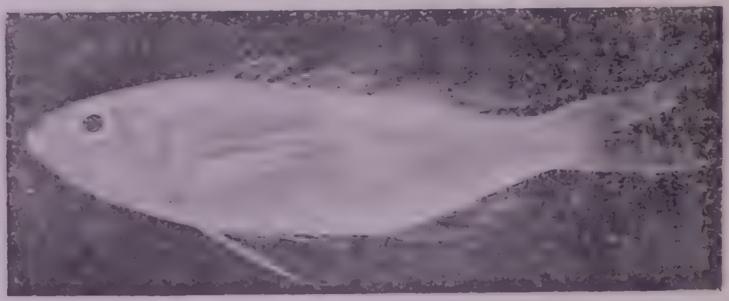


Fig. 40. *Nemipterus delagoae*

Scientific Name	:	*Nemipterus delagoae*
Vernacular Name	:	'Erragulivindalu'
Gear	:	Trawl net
Percentage in the catch of the group	:	2.0
Peak period of occurrence	:	Sep. - Dec.
Depth of occurrence	:	10 – 80 m
Length range in commercial fishery	:	90 – 250 mm
Size at first maturity	:	—
Spawning season	:	—

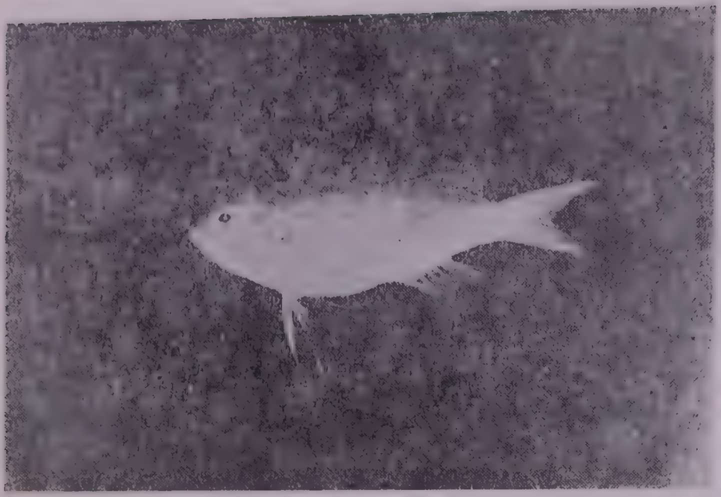


Fig. 41. *Nemipterus luteus.*

Scientific Name	:	*Nemipterus luteus*
Vernacular Name	:	'Erragulivindalu'
Gear	:	Trawl net
Percentage in the catch of the group	:	0.6
Peak period of occurrence	:	Jan.–Apr. and Jul.–Dec.
Depth of occurrence	:	10 – 80 m
Length range in commercial fishery	:	90 – 216 mm
Size at first maturity	:	—
Spawning season	:	—

NOMEIDAE

Popular English Name	:	Drift fish
Vernacular Name (Telugu)	:	'Channitichepa'
Annual average catch	:	845 t
Percentage in total catch	:	6.6
Fishing methods and their contribution	:	Trawl net : 5.0%

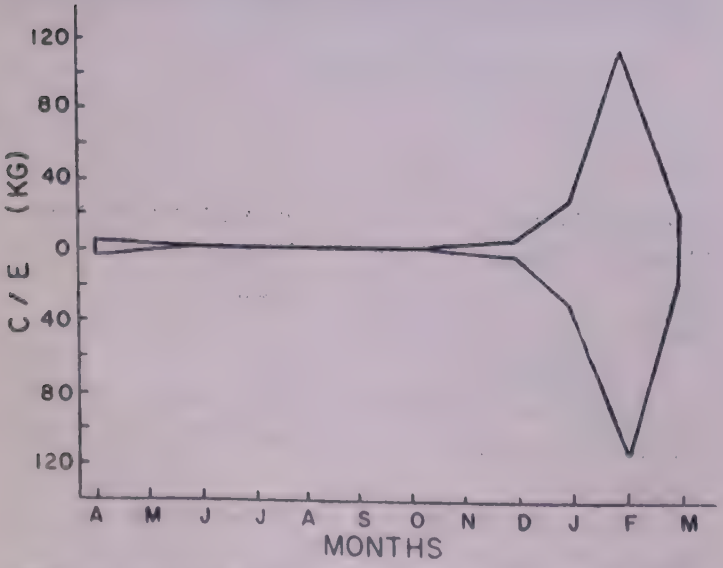


Fig. 42. Seasonal abundance of drift fishes in trawl catch.

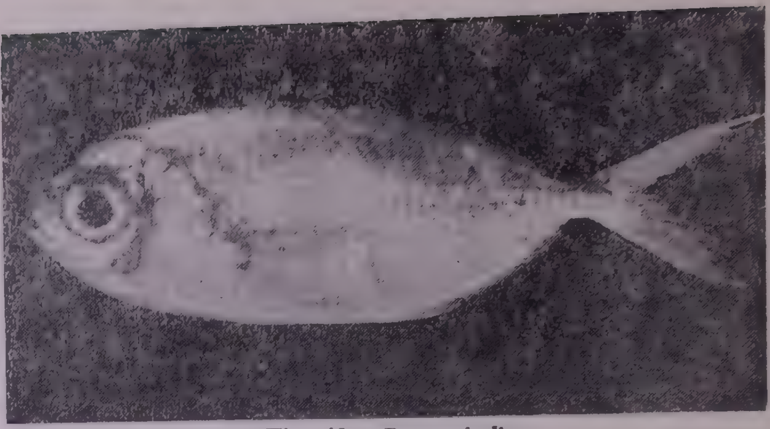


Fig. 43. *Psenes indicus.*

Scientific Name	:	*Psenes indicus*
Vernacular Name	:	'Channitichepa'
Gear	:	Trawl net
Percentage in the catch of the group	:	100
Peak period of occurrence	:	Oct. – Jan.
Depth of occurrence	:	5 – 70 m
Length range in commercial fishery	:	55 – 217 mm
Size at first maturity	:	—
Spawning season	:	—

POLYNEMIDAE

Popular English Name	:	Threadfins
Vernacular Name (Telugu)	:	'Maga'
Annual average catch	:	71 t
Percentage in total catch	:	0.6
Fishing methods and their contribution	:	Trawl net : 0.4%
Peak period of occurrence	:	Dec. – Feb.
Depth of occurrence	:	5 – 50 m

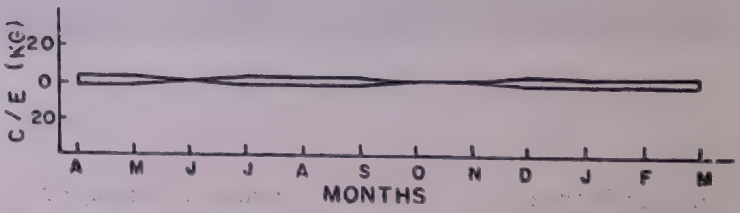


Fig. 44. Seasonal abundance of threadfins *(Polynemus)* in trawl catch.

SCIAENIDAE

Popular English Name	:	Croakers/Jew fish
Vernacular Name (Telugu)	:	'Gorasalu'
Annual average catch	:	1,039 t
Percentage in total catch	:	8.1

Fishing methods and their contribution : Trawl net : 6.3%
Gill net : 1.4%
Other units: : 2.1%

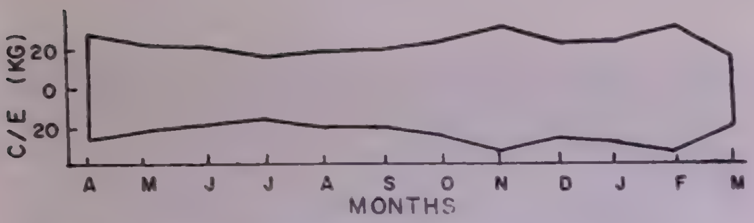


Fig. 45. Seasonal abundance of sciaenids in trawl catch.

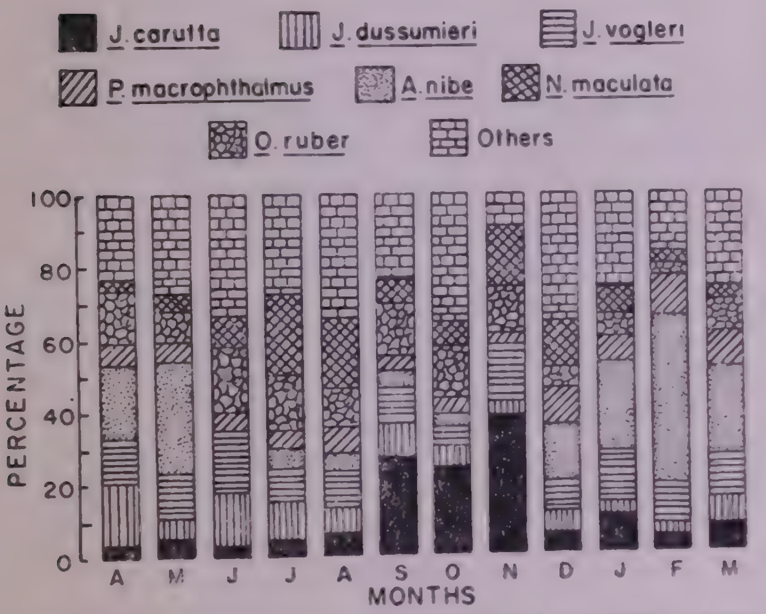


Fig. 46. Monthwise species composition of sciaenids in trawl catch.

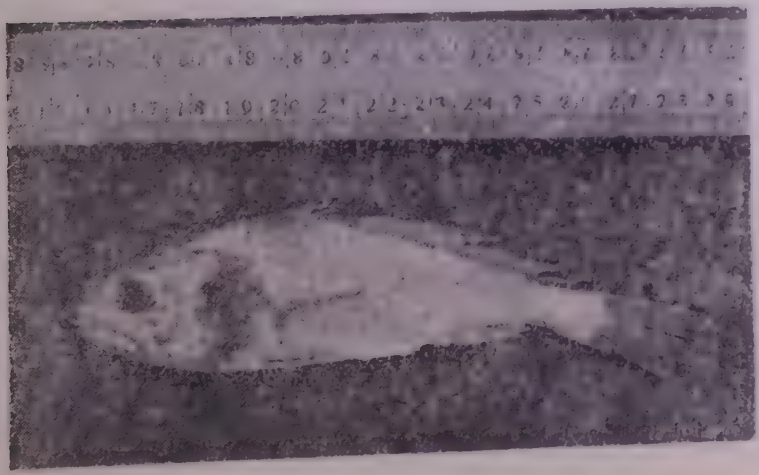


Fig. 47. *Atrobucca nibe.*

Scientific Name : *Atrobucca nibe*
Vernacular Name : 'Karrimoothigorasa'
Gear : Trawl net
Percentage in the catch of the group : 20.1
Peak period of occurrence : Jan. – May
Depth of occurrence : 5 – 60 m
Length range in commercial fishery : 90 – 235 mm
Size at first maturity : 147 mm
Spawning season : Oct. – Jun.

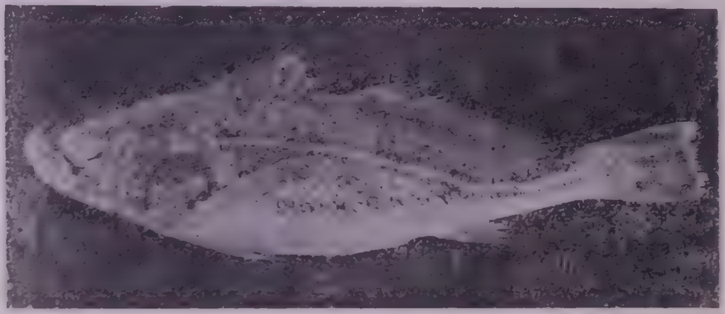


Fig. 48. *Johnius carutta.*

Scientific Name : *Johnius carutta*
Vernacular Name : 'Charagorasa'
Gear : Trawl net
Percentage in the catch of the group : 11.3
Peak period of occurrence : Sep. – Nov.
Depth of occurrence : 5 – 50 m
Length range in commercial fishery : 75 – 225 mm
Size at first maturity : 155 mm
Spawning season : Jan. – Jun.

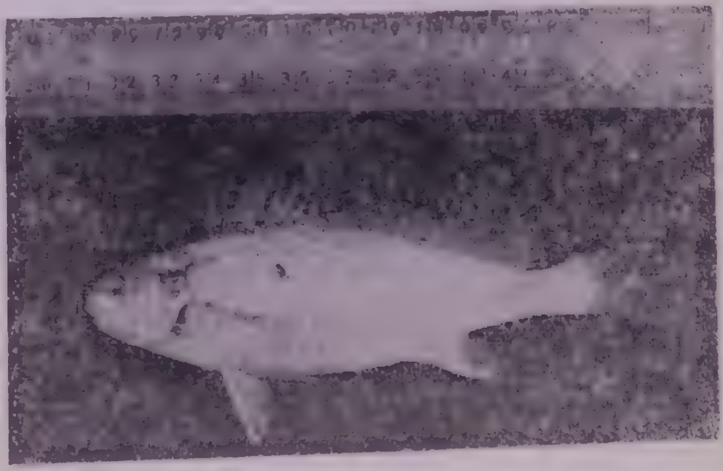


Fig. 49. *Johnius dussumieri.*

Scientific Name : *Johnius dussumieri*
Vernacular Name : 'Gorasa'
Gear : Trawl net
Percentage in the catch of the group : 7.4
Peak period of occurrence : Apr. – Jul.
Depth of occurrence : 5 – 50 m
Length range in commercial fishery : 81 - 168 mm
Size at first maturity : 110 mm
Spawning season : Mar. – Aug.

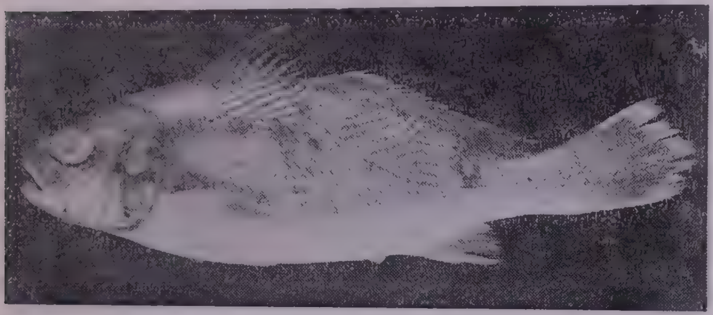


Fig. 50. *Johnius vogleri.*

Scientific Name : *Johnieops vogleri*
Vernacular Name : 'Gorasa'
Gear : Trawl net
Percentage in the catch of the group : 10.7
Peak period of occurrence : Jan. – Jun.
Depth of occurrence : 5 - 50 m
Length range in commercial fishery : 90 – 238 mm
Size at first maturity : 190 mm
Spawning season : Nov. – Jun.

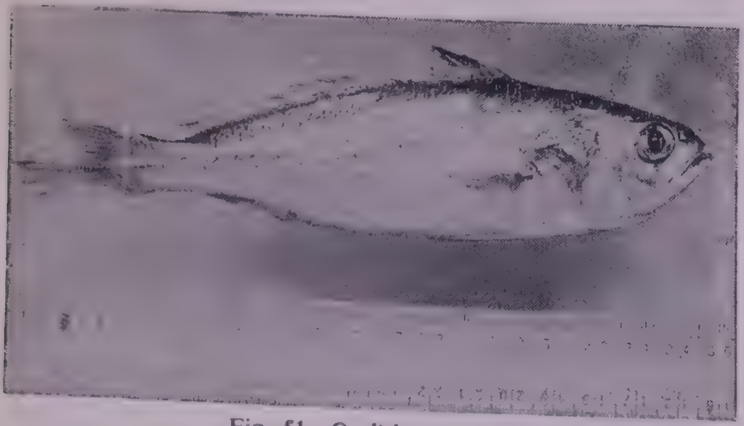


Fig. 51. *Otolithes ruber.*

Scientific Name : *Otolithes ruber*
Vernacular Name : 'Pallagorasa'
Gear : Trawl net
Percentage in the catch of the group : 9.6
Peak period of occurrence : Apr. – Nov.
Depth of occurrence : 5 – 50 m
Length range in commercial fishery : 30 – 250 mm
Size at first maturity : —
Spawning season : —

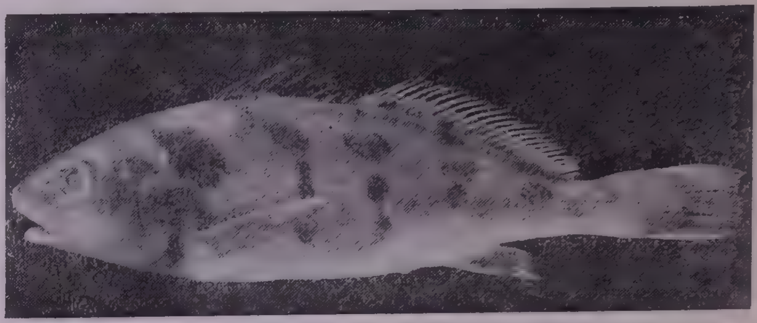


Fig. 52. *Nibea maculata.*

Scientific Name : *Nibea maculata*
Vernacular Name : 'Nallagorasa'
Gear : Trawl net
Percentage in the catch of the group : 7.9
Peak period of occurrence : Jul. – Aug.
Depth of occurrence : 5 - 50 m
Length range in commercial fishery : —
Size at first maturity : —
Spawning season : —

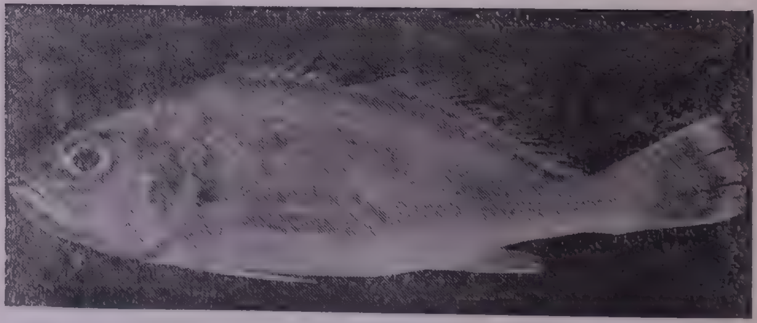


Fig. 53. *Pennahia macrophthalmus.*

Scientific Name : *Pennahia macrophthalmus*
Vernacular Name : 'Gorasa'
Gear : Trawl net
Percentage in the catch of the group : 6.3
Peak period of occurrence : Jan. – Mar. and Dec.
Depth of occurrence : 5 – 70 m

Length range in commercial fishery : 40 – 260 mm
Size at first maturity : 147 mm
Spawning season : Oct. – Jun.

SCOMBRIDAE

Popular English Name : Seer fish/Mackerel/Tuna
Vernacular Name (Telugu) : 'Vanjiram'/'Kanaguadathalu'/'Suralu'
Annual average catch : 839 t
Percentage in total catch : 6.5
Fishing methods and their contribution : Gill net : 48.0%
Trawl net : 0.6%
Other units : 5.7%

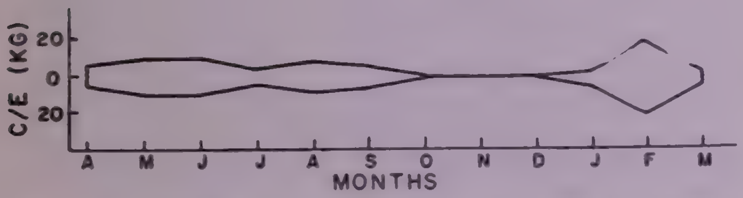


Fig. 54. Seasonal abundance of seer fishes in gill net catch.

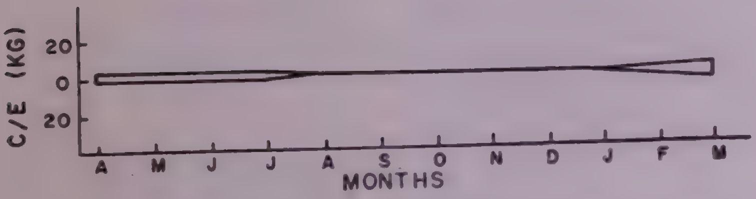


Fig. 55. Seasonal abundance of tunas in gill net catch.

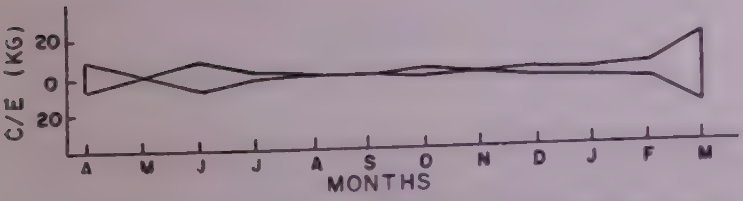


Fig. 56. Seasonal abundance of mackerel in gill net catch.

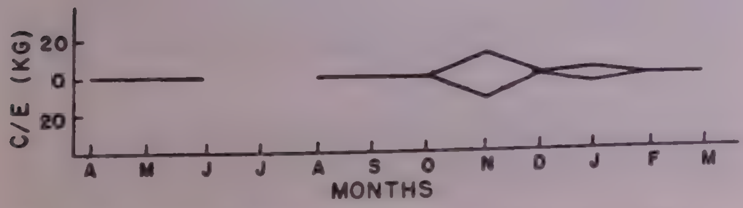


Fig. 57. Seasonal abundance of mackerel in other units.

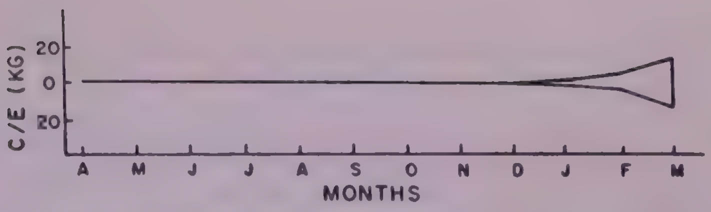


Fig. 58. Seasonal abundance of mackerel in trawl catch.

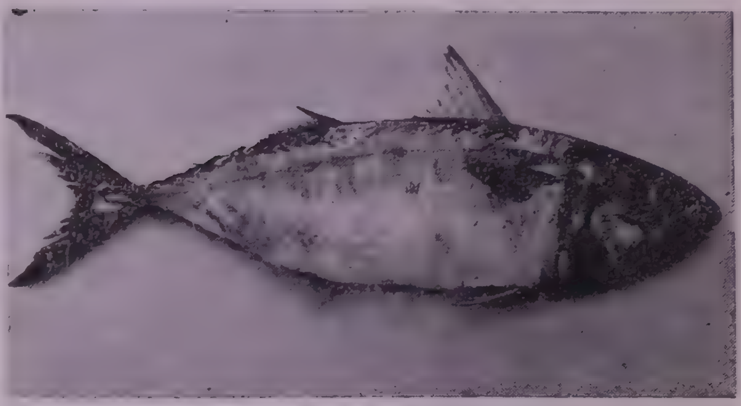


Fig. 59. *Rastrelliger kanagurta.*

Scientific Name : *Rastrelliger kanagurta*
Vernacular Name : 'Kangadathalu'
Gear : Gill net/Trawl net/Other units
Percentage in the catch of the group : Gill net : 37.3
Trawl net : 99.0
Other units : 99.0
Peak period of occurrence : Jan. – Apr. and Aug.–Dec.
Depth of occurrence : Upto 80 m
Length range in commercial fishery : 35 – 235 mm
Size at first maturity : —
Spawning season : —

SPHYRAENIDAE

Popular English Name : Barracuda
Vernacular Name (Telugu) : 'Kaijarmatta'
Annual average catch : 117 t
Percentage in total catch : 0.9
Fishing methods and their contribution : Gill net : 1.0%
Trawl net : 0.6%
Other units : 0.6%
Peak period of occurrence : Dec. – Jun.
Depth of occurrence : Upto 80 m

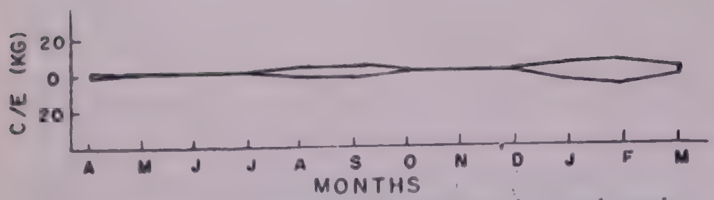


Fig. 60. Seasonal abundance of barracudas in trawl catch.

STROMATEIDAE

Popular English Name : Pomfrets
Vernacular Name (Telugu) : 'Chandua'
Annual average catch : 44 t
Percentage in total catch : 0.3
Fishing methods and their contribution : Gill net : 0.7%
Trawl net : 0.2%

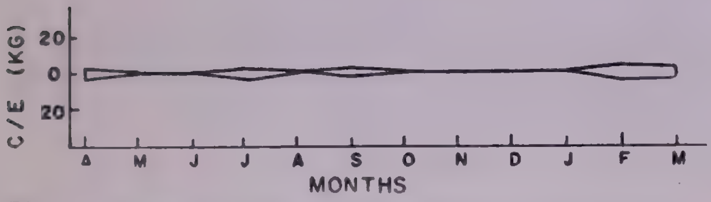


Fig. 61. Seasonal abundance of pomfrets in trawl catch.

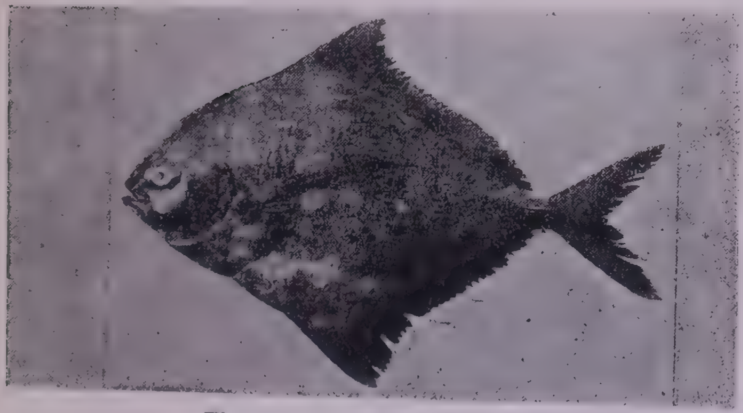


Fig. 62. *Parastromateus niger.*

Scientific Name : *Parastromateus niger*
Vernacular Name : 'Nalla chandua'
Gear : Gill net/Trawl net
Percentage in the catch of the group : —
Peak period of occurrence : Feb. – May, Aug. and Nov.
Depth of occurrence : 5 – 50 m
Length range in commercial fishery : —
Size at first maturity : —
Spawning season : —

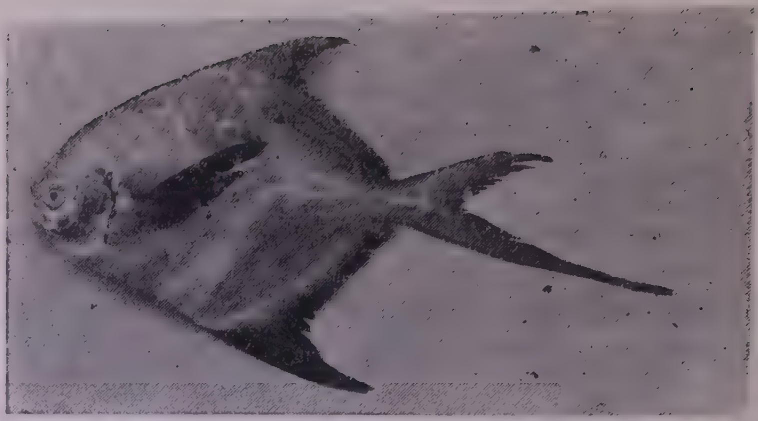


Fig. 63. *Pampus argenteus.*

Scientific Name : *Pampus argenteus*
Vernacular Name : 'Tella chandua'
Gear : Gill net/Trawl net
Percentage in the catch of the group : —
Peak period of occurrence : Apr. – Jul. and Dec.
Depth of occurrence : 5 – 50 m
Length range in commercial fishery : —
Size at first maturity : —
Spawning season : —

SYNODONTIDAE

Popular English Name : Lizard fish
Vernacular Name (Telugu) : 'Bade mattalu'
Annual average catch : 358 t
Percentage in total catch : 2.8
Fishing methods and their contribution : Trawl net : 2.1%
Gill net : 0.1%

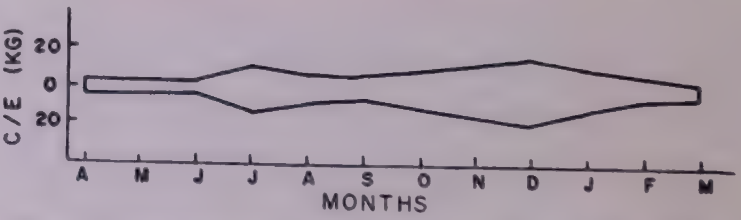


Fig. 64. Seasonal abundance of lizard fishes in trawl catch.

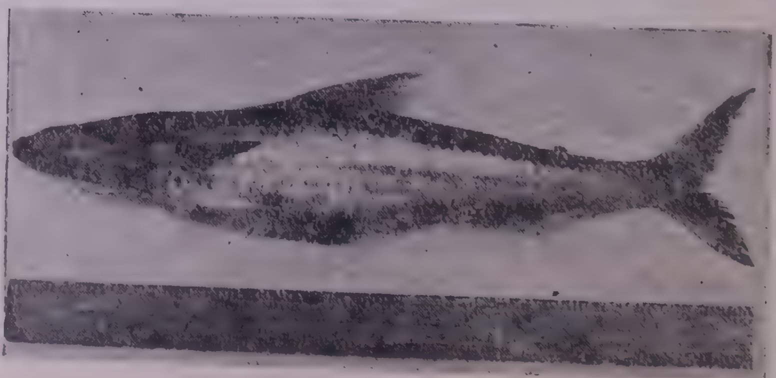


Fig. 65. *Saurida tumbil.*

Scientific Name : *Saurida tumbil*
Vernacular Name : 'Bade mattalu'
Gear : Trawl net/Gill net
Percentage in the catch of the group : 40
Peak period of occurrence : Jan., Jul. and Oct.-Dec.
Depths of occurrence : 5-70 m
Length range in commercial fishery : 170-350 mm
Size at first maturity : —
Spawning season : —

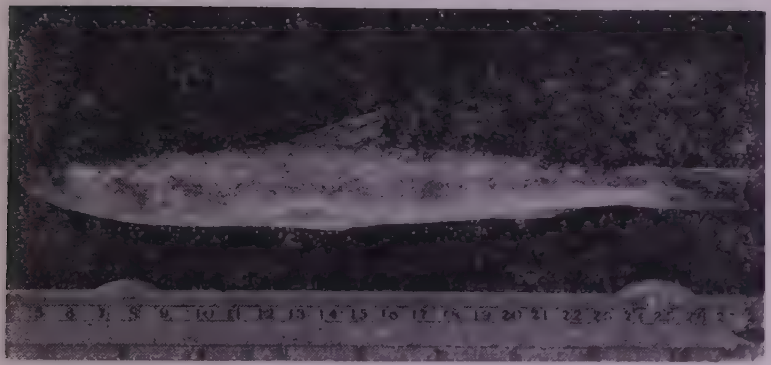


Fig. 66. *Saurida undosquamis.*

Scientific Name : *Saurida undosquamis*
Vernacular Name : 'Bade mattalu'
Gear : Trawl net/Gill net
Percentage in the catch of the group : 20
Peak period of occurrence : Jan., Jul. and Oct.– Dec.
Depth of occurrence : 5-70 m
Length range in commercial fishery : —
Size at first maturity : —
Spawning season : —

RHINOBATIDAE

Popular English Name : Shovel-nose ray/Skate
Vernacular Name (Telugu) : 'Teku'
Annual average catch : 61 t
Percentage in total catch : 0.4
Fishing methods and their contribution : Trawl net : 0.4%
Peak period of occurrence : Dec.-Mar.
Depth of occurrence : 3-80 m

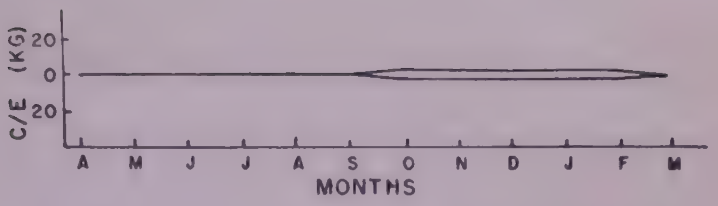


Fig. 67. Seasonal abundance of skates in trawl catch.

TACHYSURIDAE

Popular English Name : Cat fish
Vernacular Name (Telugu) : 'Jellalu'/'Jella'
Annual average catch : 459 t
Percentage in total catch : 3.6
Fishing methods and their contribution : Trawl net : 2.6%
Gill net : 1.7%
Peak period of occurrence : Jan.- Jun.
Depth of occurrence : 5-80 m

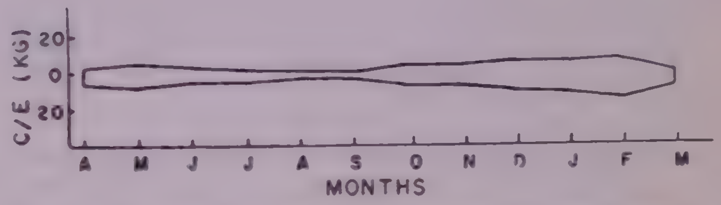


Fig. 68. Seasonal abundance of cat fishes in trawl catch.

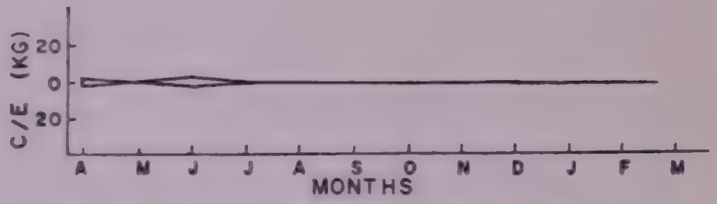


Fig. 69. Seasonal abundance of cat fishes in gill net catch.

TRICHIURIDAE

Popular English Name : Ribbon fish
Vernacular Name (Telugu) : 'Savallu'
Annual average catch : 1,405 t
Percentage in total catch : 10.9
Fishing methods and their contribution : Trawl net : 7.1%
Gill net : 2.4%
Other units : 49.3%

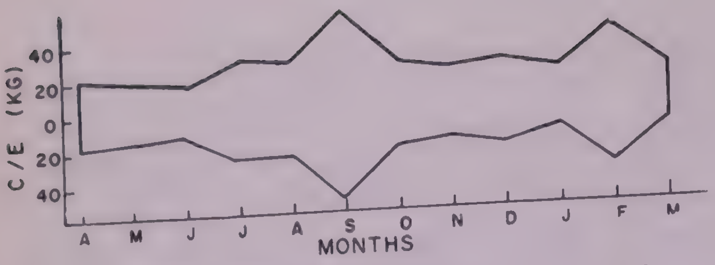


Fig. 70. Seasonal abundance of ribbon fish in trawl catch.

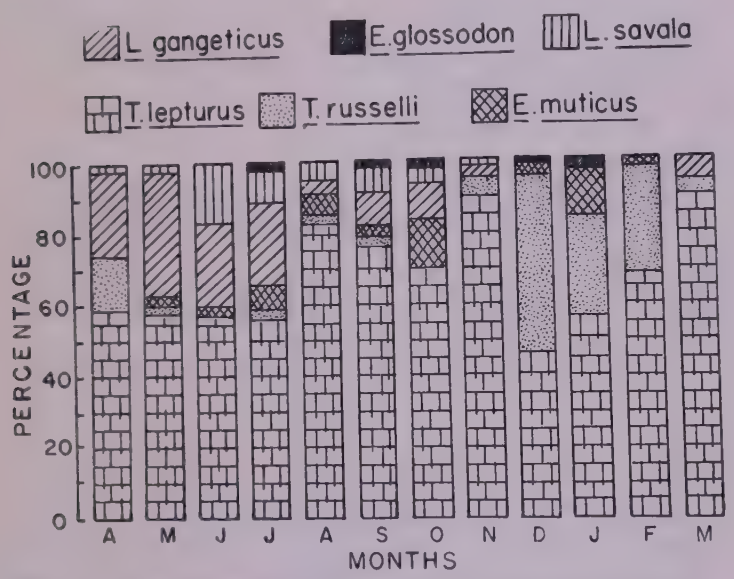


Fig. 71. Monthly species composition of ribbon fishes in trawl catch.

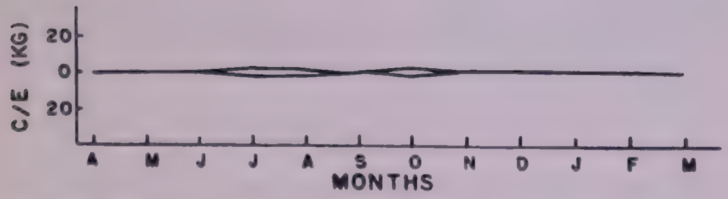


Fig. 72. Seasonal abundance of ribbon fish in gill net catch.

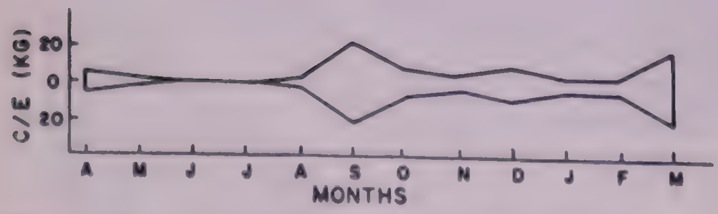


Fig. 73. Seasonal abundance of ribbon fish in other units.

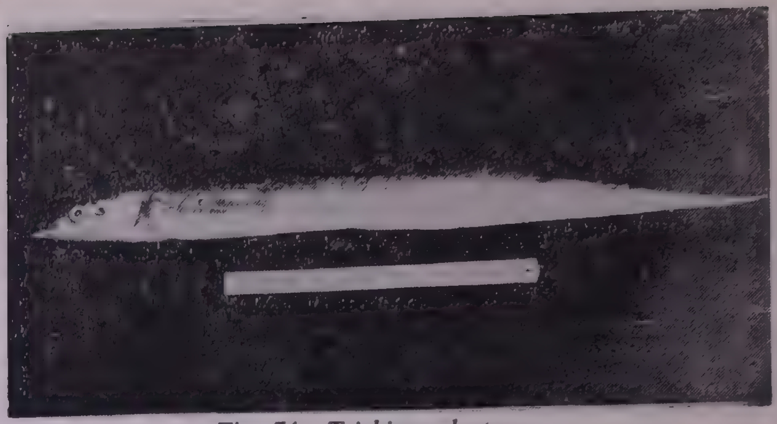


Fig. 74. *Trichiurus lepturus.*

Scientific Name	:	*Trichiurus lepturus*
Vernacular Name	:	'Patti savallu'
Gear	:	Trawl net
Percentage in the catch of the group	:	73
Peak period of occurrence	:	Oct. – Dec.
Depth of occurrence	:	5 – 50 m
Length range in commercial fishery	:	165 – 1,150 mm
Size at first maturity	:	525 mm
Spawning season	:	Feb. – Jun.

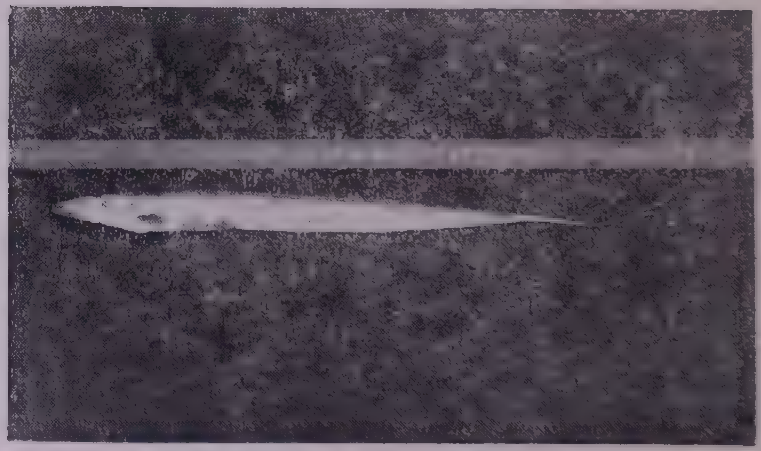


Fig. 75. *Lepturacauthus gangeticus.*

Scientific Name	:	*Lepturacanthus gangeticus*
Vernacular Name	:	'Savallu'
Gear	:	Trawl net
Percentage in the catch of the group	:	12.9
Peak period of occurrence	:	Jan. – Dec.
Depth of occurrence	:	5 – 50 m
Length range in commercial fishery	:	195 – 585 mm
Size at first maturity	:	—
Spawning season	:	May – Jul.

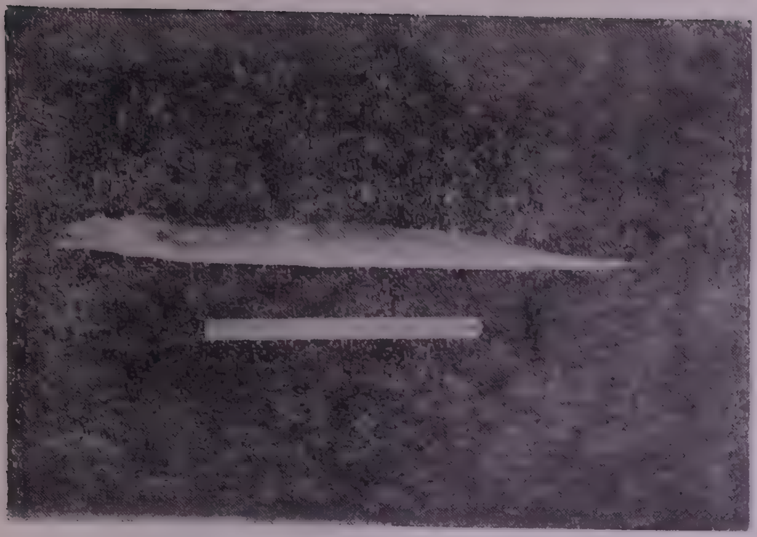


Fig. 76. *Lepturacanthus savala.*

Scientific Name : *Lepturacanthus savala*
Vernacular Name : 'Savallu'
Gear : Trawl net
Percentage in the catch of the group : 4.6
Peak period of occurrence : Jul. - Aug.
Depth of occurrence : 5 - 50 m
Length range in commercial fishery : 200 - 700 mm
Size at first maturity : —
Spawning season : —

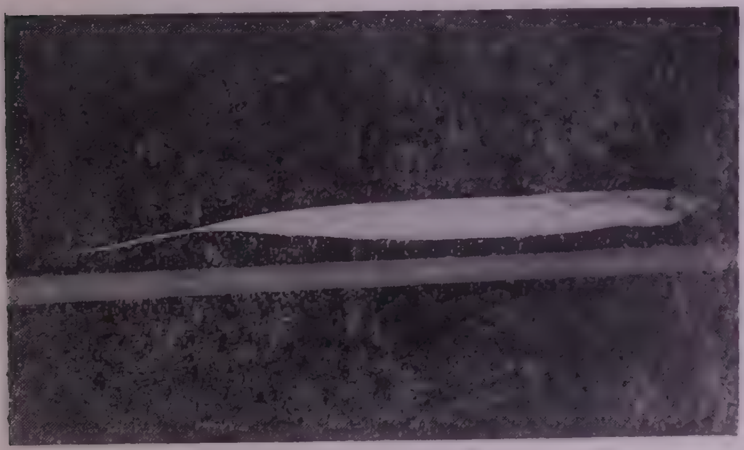


Fig. 77. *Eupleurogrammus muticus.*

Scientific Name : *Eupleurogrammus muticus*
Vernacular Name : 'Savallu'
Gear : Trawl net
Percentage in the catch of the group : 4.2
Peak period of occurrence : Jul. – Aug.
Depth of occurrence : 5 – 50 m
Length range in commercial fishery : 160 – 460 mm
Size at first maturity : —
Spawning season : May – Nov.

TRYGONIDAE & MYLIOBATIDAE

Popular English Name : Rays
Vernacular Name (Telugu) : 'Teku'
Annual average catch : 312 t
Percentage in total catch : 2.4
Fishing methods and their contribution : Trawl net : 1.9%
Peak period of occurrence : Nov. – Apr.
Depth of occurrence : 5 – 50 m

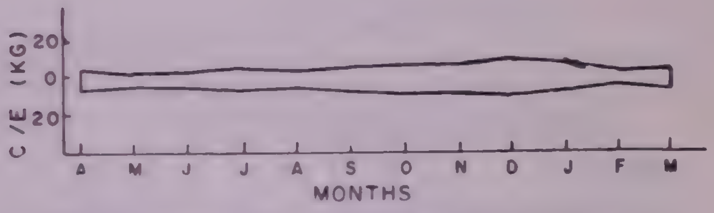


Fig. 78. Seasonal abundance of rays in trawl catch.

SALINITY CHANGES IN THE ESTUARY AND THE COASTAL SEA ADJACENT TO THE PORTMOUTH AT COCHIN*

Introduction

The Vembanad Lake south of Cochin to which five major rivers join, and with its permanent connection with the Arabian Sea at Cochin provides excellent opportunities to observe the influence of the coastal sea over the estuary and *vice versa.* As the rivers of the region are rainfed and seasonal the estuary has no other influence to upset its seasonal rhythm. On the other hand, the Cochin mouth being a permanent one, facilitates unhindered flow of seasonal flood water into the sea as well as the saline water into the estuary by tidal effect. The coastal sea plays a predominant role in determining the characteristics of the estuary except during incessant heavy rain during the southwest monsoon season. The flow from and into the sea ensures the exchange of water and effective dispersal of pollutants. The Cochin mouth is situated in a strategic position between the southern and the northern parts of the Vembanad Lake and consequently the flow in and out of the two parts of the lake occurs simultaneously.

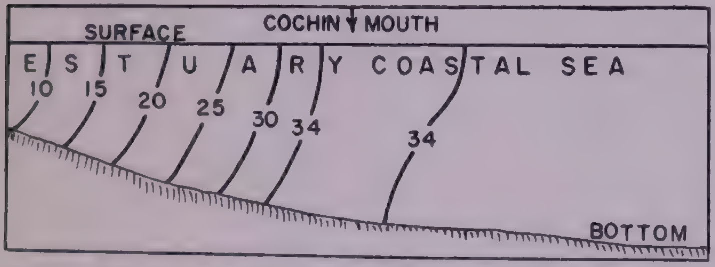


Fig. 1. Salinity (parts per thousand) of the different sections of the estuary and the coastal sea in the pre and postmonsoon season (Not according to scale).

The premonsoon and the postmonsoon conditions of salinity depicted in Fig. 1 show that during the summer months the waters in the Vembanad Lake and the adjacent coastal sea are vertically well mixed with salinity values increasing from the head of the estuary to the Cochin mouth. The salinity of the lower estuary is almost the same as that of the coastal sea during this period.

The southwest monsoon that normally sets in over Kerala early in June floods the rivers. The flood water, being lighter than the receiving saline water, flows at the surface towards the sea and on its way erodes and replaces a little of the water below (Fig. 2). Consequently, as the season advances the area having the properties of the flood water both at the surface and the bottom extends from the head towards the lower estuary. The water flowing out through the Cochin mouth being still lighter than the coastal sea water entrains a little of the latter from below while it spreads over a wide area as a 'plume' adjacent to the Cochin mouth, turning the coastal region into a functional extension of the estuary. Thus, the Cochin coastal region where the 'plume' layer spreads over the more denser coastal sea water resembling closely a saltwedge estuary in its flow characteristics, becomes an *'intermittent estuary'* during the occurrence of the 'plume' though this area lies outside the limits which normally marks the boundaries of an estuary. The boundary between the 'plume' and the sea water is well marked by the change in the colour from a highly turbid surface to clear bright greenish blue.

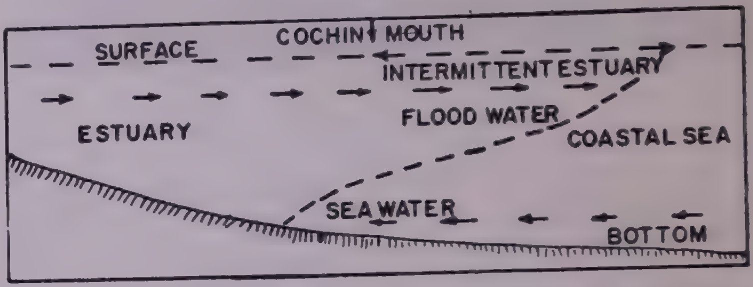
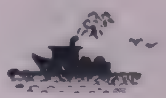


Fig. 2. Vertical distribution of the flood and the sea water in the estuary and the coastal sea during the Southwest monsoon season (Not according to scale).

As the riverine discharge into the Vembanad Lake and the outflow through the Cochin mouth decrease considerably in the post-monsoon season, the sea water invading the region along the bottom rises to the surface and subsequently the transient estuary in the coastal region disappears and the different stretches of the estuary regain their characteristics of the premonsoon season.



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* Prepared by S. Muthusamy, C. P. Ramamirtham, N. P. Kunhikrishnan, L. R. Khambadkar, A. Nandakumar and A.V.S. Murty, CMFRI, Cochin.

STOMATOPOD RESOURCES OF THE SOUTH KANARA COAST DURING 1983-'86*

Introduction

Among the crustaceans exploited by commercial nets, perhaps, stomatopods are economically the least important. They are not consumed in our country at present due to their lesser flesh content as well as the presence of large number of spines on the body. The landings of stomatopods have been exceptionally high in Karnataka particularly along the South Kanara coast. Around 50% of the all India stomatopod catch is obtained from Karnataka alone.

In the sixties and early seventies, stomatopods, locally known as 'pucha' or 'puchi', were used to be thrown out into the sea by shrimp trawlers due to lack of space on board. Of late, it has been found that it is a good raw material for converting into fish meal, poultry feed and manure, and hence there is a lot of demand for the same by the fish meal plants. It also fetches a reasonable price in recent years. In the present account an appraisal of the fishery and utilisation of this valuable resource is attempted based on the data collected during 1983-'86.

Craft and gear

There is no craft or gear as such exclusively used for catching stomatopods. Generally, it is being obtained as incidental catches by mechanised boats while trawling for prawns.

Fishing seasons

Eventhough trawling commences in September, stomatopods start appearing in the catch only in November along the South Kanara coast and last till May or early June.

Stomatopod landing

Mangalore

The annual catch amounted to 2,649.5 t with a catch per boat day of 64.2 kg during 1983-'84 (Table 1). The following season witnessed 115% increase in stomatopod landings as compared to the previous season. The catch was to the tune of 5,495.2 t (97.9 kg/boat day) during this period. The 1985-'86 season registered a fall in stomatopod landings by 818.0 t and the catch was 4,677.2 t but the catch/boat day was 108.8 kg.

Table 1. *Monthwise stomatopod landings by shrimp trawlers during* 1983-'84, 1984-'85 *and* 1985-'86 *seasons at Mangalore*

	1983-'84		1984-'85		1985-'86	
Month	No. of units	Catch (t)	No. of units	Catch (t)	No. of units	Catch (t)
Sep.	2,627	—	4,995	—	338	—
Oct.	630	—	2,028	—	496	—
Nov.	2,713	1.0	4,123	14.1	2,130	90.0
Dec.	4,131	411.7	9,416	940.0	4,680	558.3
Jan.	7,174	748.7	9,585	1,595.7	7,626	952.8
Feb.	6,228	585.5	7,720	1,005.2	8,733	1,036.2
Mar.	6,240	318.9	7,325	886.3	6,732	687.6
Apr.	5,340	263.8	7,049	686.3	7,125	939.8
May	6,204	319.9	3,887	367.6	5,126	412.5
Jun.	—	—	—	—	—	—
Total	41,287	2,649.5	56,128	5,495.2	42,986	4,677.2

Stomatopods formed 24.8% (1983 - '84 season) to 37.2% (1985-'86 season) of the trawl landings at Mangalore (Fig. 1).

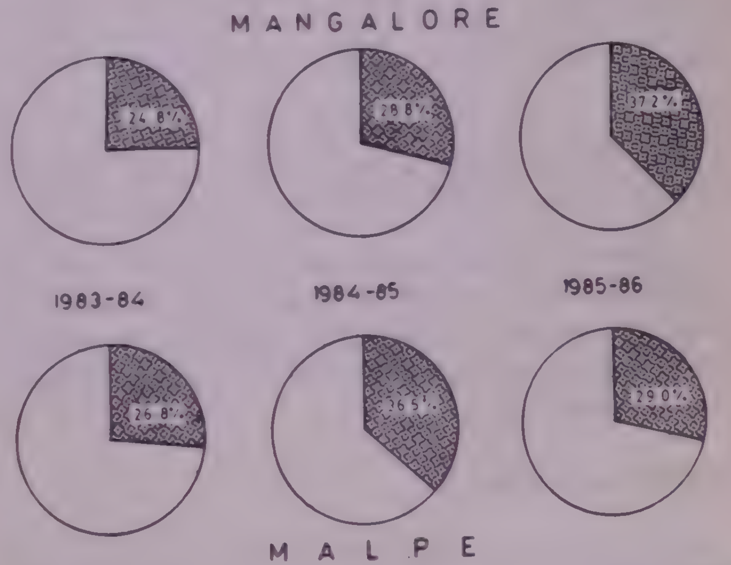

Fig. 1. Percentage contribution of stomatopods in total trawl landings during various seasons at Mangalore and Malpe Fisheries Harbour.

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* Prepared by K. K. Sukumaran, Mangalore Research Centre of CMFRI, Mangalore.

Eventhough stomatopods are landed from November to May, generally peak catches are obtained during November–February. The maximum catches were obtained in January '84 (747.7 t), January '85 (1,595.7 t) and February '86 (1,036.2 t) at this centre.

Malpe Fisheries Harbour

It is estimated that 1,729.2 t of stomatopods with a catch/boat day of 46.3 kg were landed at this centre during 1983-'84 (Table 2). The fishery registered 180% improvement during the following season (1984–'85) and the catch amounted to 4,847.5 t (103 kg/boat day). During 1985–'86 season, the fishery showed a fall by 36.0 % and the catch was to the tune of 3,102.3 t with a catch/boat day of 94.8 kg. It is seen that stomatopods contributed from 26.8% (1983–'84 season) to 36.5% (1984–'85) of the trawl landings at this centre (Fig. 1).

Table 2. *Monthwise stomatopod landings by shrimp trawlers during* 1983–'84, 1984–'85 *and* 1985–'86 *seasons at Malpe*

	1983–'84		1984–'85		1985–'86	
Month	No. of units	Catch (t)	No. of units	Catch (t)	No. of units	Catch (t)
Sep.	5,275	—	10,987	—	3,875	—
Oct.	450	—	4,030	—	1,560	—
Nov.	3,204	17.9	4,800	210.7	2,438	246.9
Dec.	3,553	500.3	5,150	911.5	3,300	325.5
Jan.	4,342	408.4	6,600	1,906.7	2,350	211.2
Feb.	4,121	238.1	3,520	655.7	3,294	257.3
Mar.	4,622	149.8	2,704	464.3	4,150	542.3
Apr.	4,163	242.6	4,725	517.7	6,450	906.2
May	7,622	172.1	3,308	180.9	5,310	612.9
Jun.	—	—	—	—	—	—
Total	37,352	1,729.2	45,824	4,847.5	32,727	3,102.3

Generally peak catches were obtained during December–February and in April. The highest landings were recorded in December '83 (500.3 t), January '85 (1,906.7 t) and April '86 (906.2 t) during the three seasons under study.

Species composition

The stomatopod fishery is exclusively supported by a single species namely *Oratosquilla nepa* all along the coast.

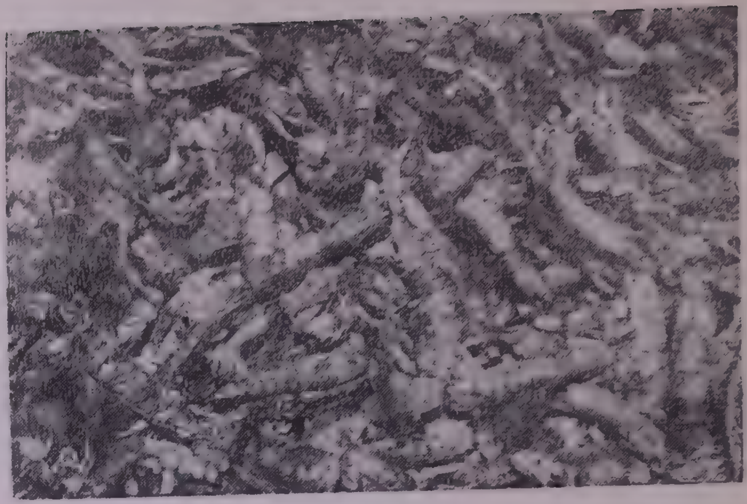

Fig. 2. Stomatopods - a close up view.

Disposal of the catch

At Mangalore, the entire catch in a boat is auctioned as a lot. It is usually purchased by some agents who in turn supply it to the fish meal plants at Ullal nearby.

At Malpe Fisheries Harbour, a few baskets are auctioned together or the whole catch is auctioned as a lot by fishermen themselves. Often it is seen that stomatopods are auctioned along with prawns (small varieties) to fetch a better price instead of sorting out and auctioning them separately.

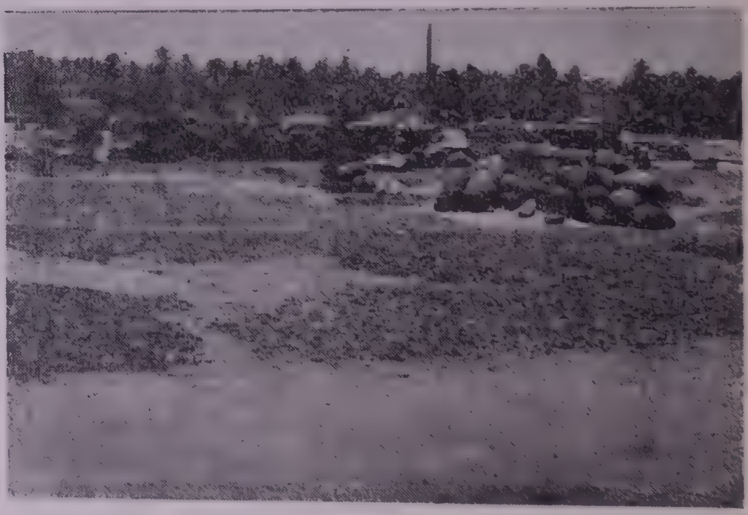

Fig. 3. Sun dried stomatopods packed in gunny bags ready for transportation at Malpe Fisheries Harbour.

Utilisation

The stomatopods are mostly sun-dried in the harbour premises (Figs. 2 & 3). After drying they are packed in gunny bags and sold as manure or to nearby fish meal plants for converting into poultry feed.

The price of stomatopods vary from Rs. 750 to 1,500 per tonne in the raw condition and Rs. 2,000 to 3,000 in the dried condition.

Eventhough the flesh content in squilla is relatively low, the protein content is very high, and hence the possibility of consuming it as food or converting it into food products may be seriously thought of.

Feasibility studies have been already carried out by Central Institute of Fisheries Technology, Cochin and Central Food Technological Research Institute, Mysore for extracting *chitosan,* a highly valuable commercial product, from the exoskeleton of stomatopods in the recent past. Unfortunately, nobody has come forward to take up the production of *chitosan* on a commercial scale, perhaps due to the high cost involved in its production.

It is high time that researches are directed to evolve low cost technologies for the manufacture of cheap food products from stomatopods and also for the extraction of highly priced *chitosan* on a commercial basis thereby utilising this plentiful resource in an advantageous manner.

SOME ASPECTS ON THE FISHERY AND BIOLOGY OF PERISCOPE SHRIMP FROM BOMBAY WATERS*

Introduction

The Periscope shrimp *Atypopenaeus stenodactylus* Stimpson constitutes a fishery at Versova by 'dol' net. The annual average landing was reported to be 105 tonnes at this centre constituting about 3.3% of total 'dol' net landings of prawns at this centre (Kunju, 1967, *Proc. Symp. Crust.*, **4**: 1382–97). The fishery is seasonal lasting from November to May. A comparative study of fishery of this little known species is given for the years 1983 and 1984 at Versova and Sassoon Dock.

The area of operation for *A. stenodactylus* at Sassoon Dock is off Murud-Harnai coasts of Maharashtra. The operational depth may range from 27 to 70 m.

The landings at Versova were estimated for 'dol' landings considering each boat net combination as a fishing unit. At Sassoon Dock only mechanised country craft trawlers that brought medium sized penaeids such as *Metapenaeopsis stridulans* during March–May were considered for study and estimation of the landings of periscope shrimps. The monthwise landings by 'dol' net at Versova are given in Table 1.

The percentage of this species in total prawn landings by 'dol' at Versova was estimated at 3.5 and 2.8 respectively for 1983 and 1984. The considerable decline in the magnitude of catches at Versova during 1984 may be attributed to the general decline in catches of prawns.

Table 1. *Monthwise landings of Periscope shrimp by 'dol' net at Versova during* 1983–'84

	Catch (kg)	
Month	1983	1984
January	21,500	2,005
February	11,500	3,015
March	21,000	4,015
April	21,500	3,010
May	31,500	2,010
June	—	—
July	—	—
August	—	—
September	—	—
October	—	—
November	48,500	2,000
December	51,290	2,427
Total	2,06,790	18,482

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* Prepared by M. Aravindakshan and J. P. Karbhari, Bombay Research Centre of CMFRI, Bombay.

The landings by trawlers at Sassoon Dock are given in Table 2.

Table 2. *Landings of Periscopc shrimp by trawlers at Sassoon Dock.*

Months	Catch (kg.) 1983	Catch (kg.) 1984
March	4,415	4,210
April	3,315	3,118
May	2,274	3,577
Total	10,004	10,905

The quantity landed at Sassoon Dock was much less than that landed at Versova. This might be due to the escaping of juveniles through the large meshes of the net (3 cm) as compared to that of 'dol' nets (1 cm) and also due to the different depth ranges where the nets were operated. At Sassoon Dock the landings constituted 1.5% of total prawn landings.

Variations were noticed with regard to size range and sex ratio at each centre. The total length was found to range from 22–38 mm at Versova with a sex ratio of 1:3 with female dominance (Table 3). In trawler landings at Sassoon Dock, females were always dominant. A size range of 40–65 mm was noticed for the specimens from trawler catches at Sassoon Dock.

Table 3. *Month-wise sex ratio of* A. stenodactylus *at Versova and Sassoon Dock*

Place	Month	1983 Male %	1983 Female %	1984 Male %	1984 Female %
Versova	January	48	52	46	54
,,	February	50	50	50	50
,,	March	43	57	42	58
,,	April	50	50	50	50
,,	May	60	40	48	52
,,	June	—	—	—	—
,,	July	—	—	—	—
,,	August	—	—	—	—
,,	September	—	—	—	—
,,	October	—	—	—	—
,,	November	50	50	48	52
,,	December	48	52	52	48
Sassoon Dock	March	30	70	22	78
,,	April	20	80	15	85
,,	May	22	78	18	82

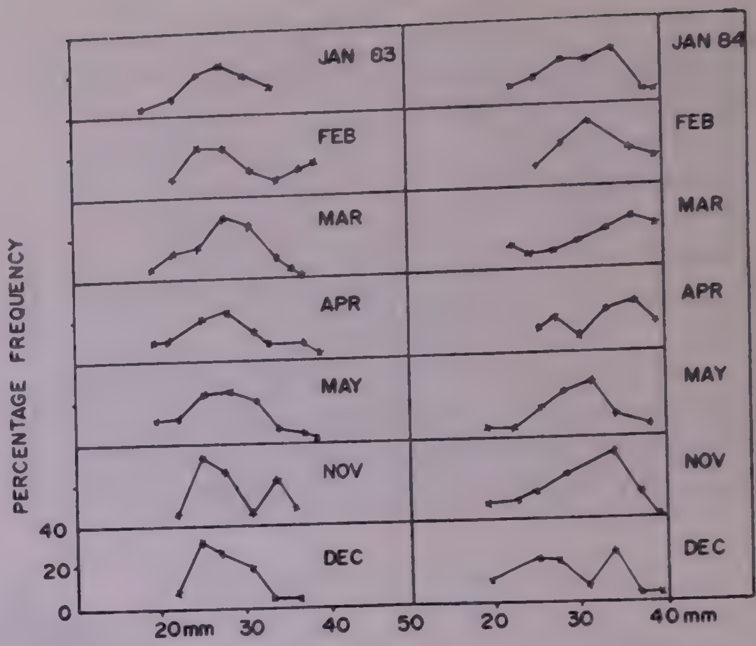

Fig. 1. Length frequency distribution of *Atypopenaeus stenodactylus* Stimpson at Versova (Dol net).

'Dol' catch

The dominant mode at 25 mm was noticed in November and December 1983. During the other months the main mode remained at 28 mm for 'dol' net at Versova. In 1984 the dominant mode was at 35 mm for January, November and December. During other months,chief mode was at 33 mm with slight progression in March and April when the mode stood at 38 mm (Fig. 1).

Trawler catch

In 1983 the mode at 56 mm had dominated in March which more or less continued upto April. It shifted to 60 mm in May. During 1984 dominant mode at 58 mm was found to continue in April and May (Fig. 2).

Of the 620 specimens of size range 22-65 mm analysed crustacean appendages, sand grains and debris constituted the major food items.

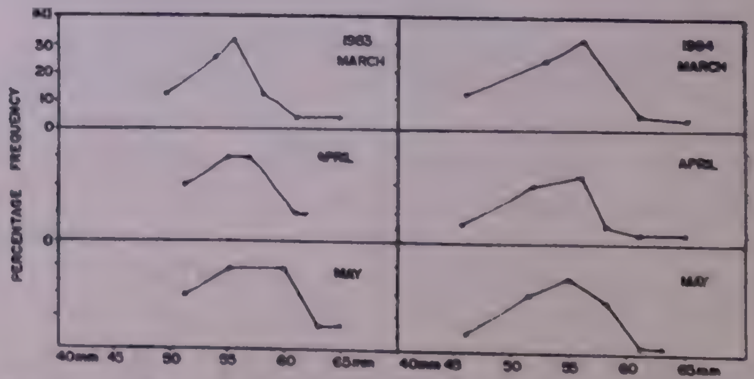

Fig. 2. Length frequency distribution of *Atypopenaeus stenodactylus* Stimpson at Sassoon Dock (Trawl net).

The crustacean appendages were mainly of copepods and decapod crustaceans. This formed about 75% of the food injested. Sand grains and debris constituted 20% and foraminifera 5% of the total stomach contents.

The specimens found in 'dol' nets were immature. Mature females were rarely noticed. In trawler landings which were mostly females, the percentage of mature specimens was as high as 80%. This indicated that the species spawned during these months. The sudden appearance of this species in November in 'dol' catches at Versova suggests their shoreward movement from deeper waters where spawning takes place.

This species being small, does not attract a ready market in fresh conditions. The 'dol' catches are sun-dried whereas trawl net landings are sold along with medium sized penaeids.

ON A SEASONAL HOOKS AND LINE FISHERY WITH CATAMARANS ALONG CALICUT COAST*

Though information on catamarans and associated hooks and line fishery along the southern part of south-west coast and east coast is fairly adequate (Anon. 1981, *Mar. Fish. Infor. Serv., T & E Ser.*, 69: 23-28), we have practically no information on the same along the Malabar coast. The present report embodies a brief account on the catamaran fishery at Calicut during November and December, 1986.

The catamaran fishermen of Trivandrum and Kanyakumari coasts migrate along the Malabar coast for fishing during October to January. During this period the weather becomes unfavourable for fishing in their traditional fishing grounds due to northeast wind. They even go upto Karwar braving the sea in their catamarans driven by sail, and catch quality fishes using hooks and line. During this season, as fish landing by local fishing gears along the Calicut coast is poor, their catches fetch good price.

At Calicut each catamaran is operated by two fishermen (Fig. 1). They use two sets of hooks and lines (Fig. 2). The hooks are about 8 cm long made of iron rod of 1.5 mm thickness. The baitfish is attached to the hook and is covered with a metallic cap (Fig. 3).

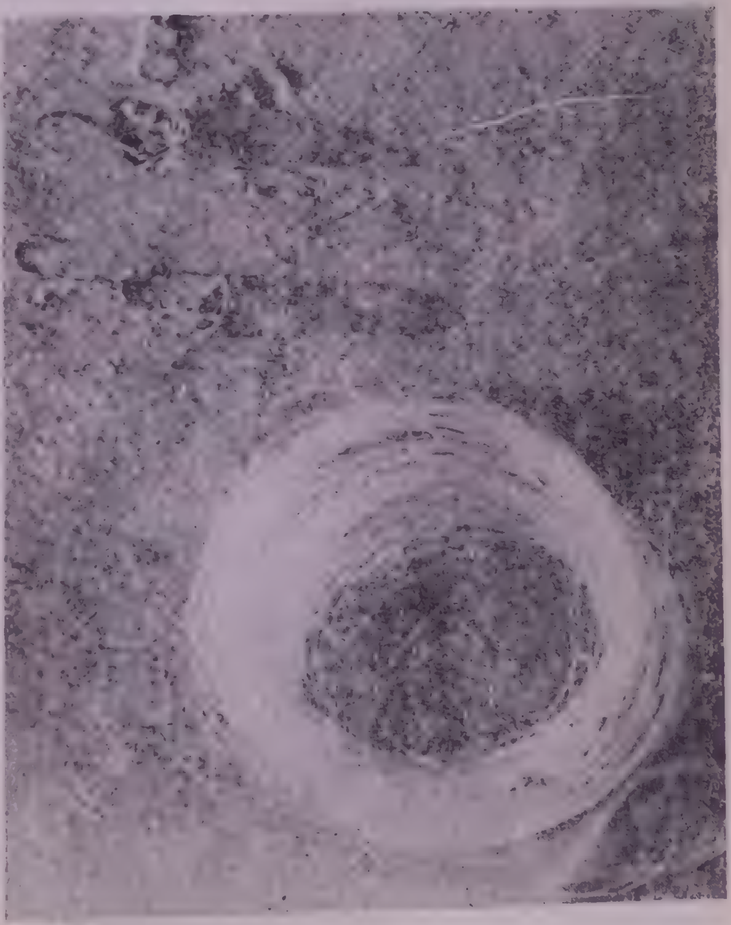

Fig. 2. Hooks and line used by the catamaran fishermen.

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* Prepared by R. S. Lal Mohan and K. Nandakumaran, Calicut Research Centre of CMFRI, Calicut.

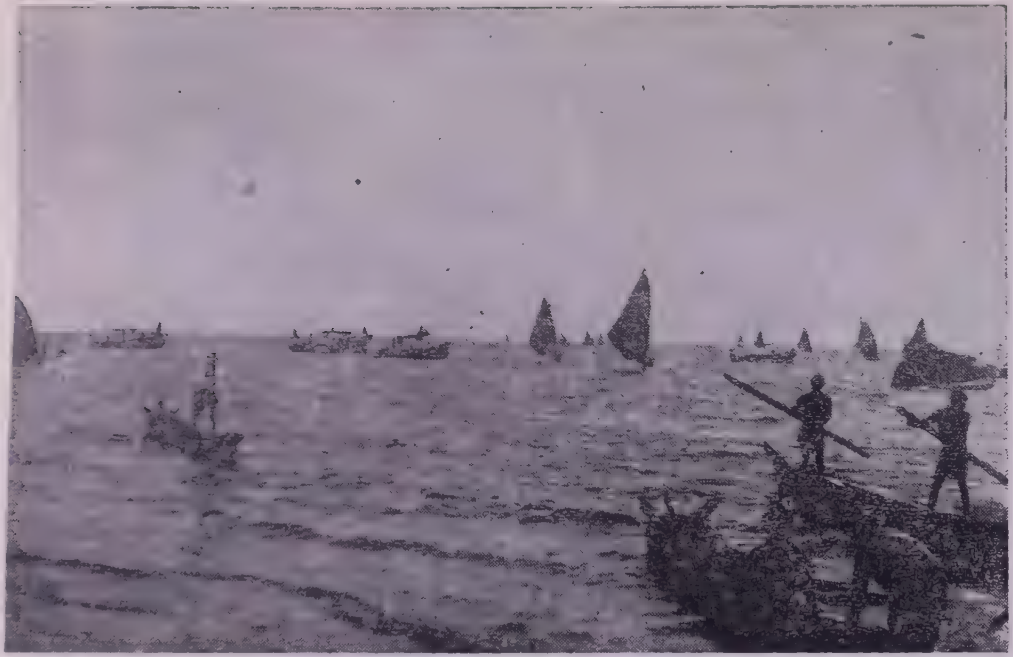

Fig. 1. Catamarans with sails off Calicut coast (Puthhiappa).

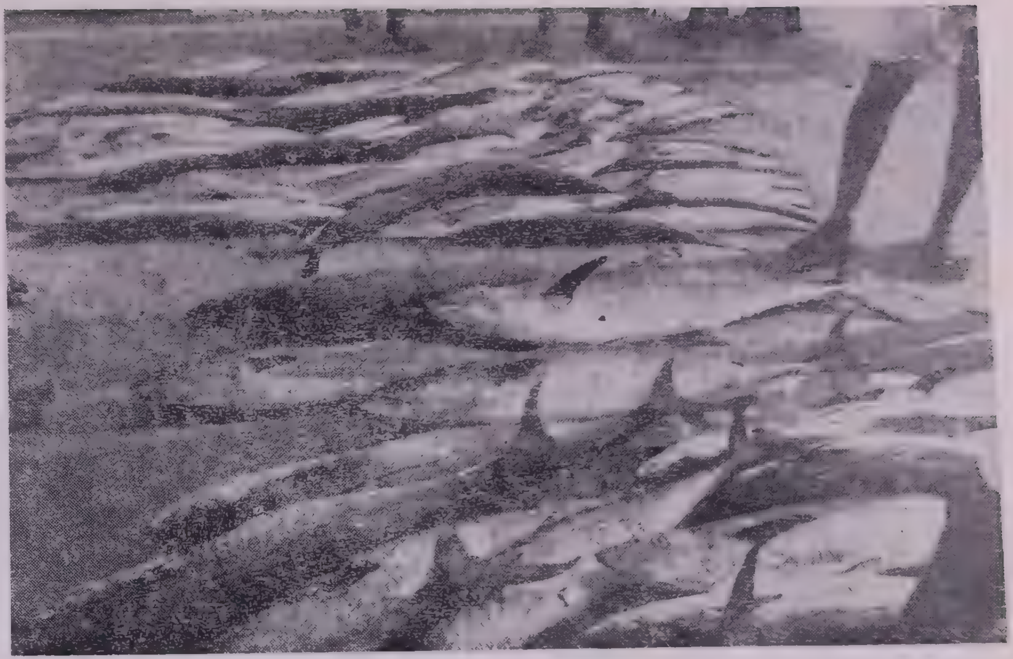

Fig. 4. Part of the landings - *Scomberomorus commerson* and *Sphyraena barracuda*.

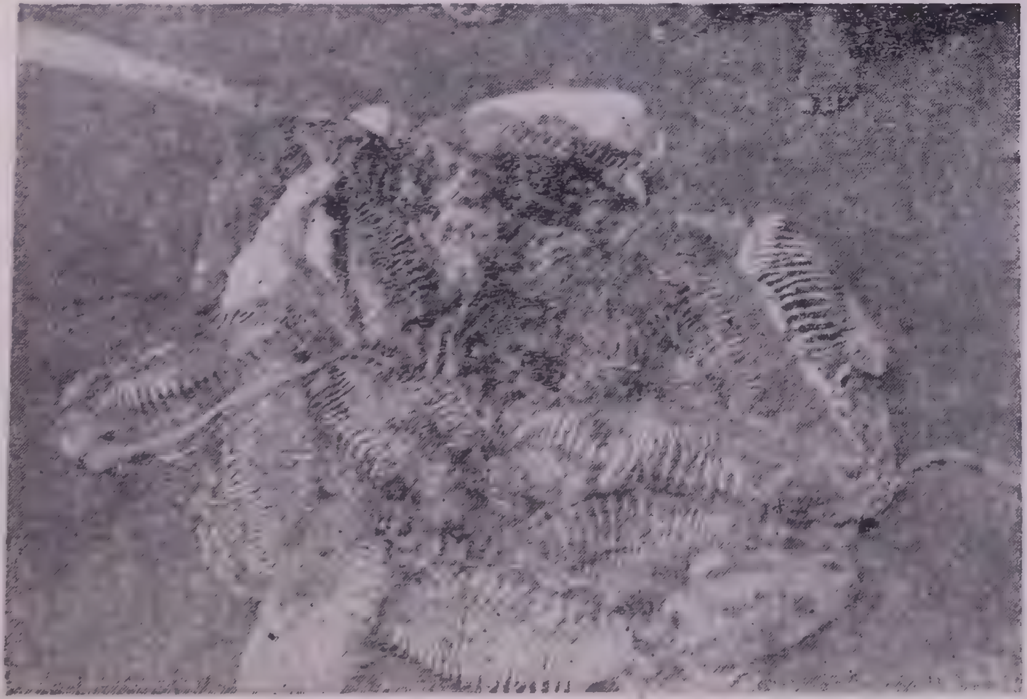

Fig. 5. A part of the catch of *Sepia pharaonis* by hooks and line.

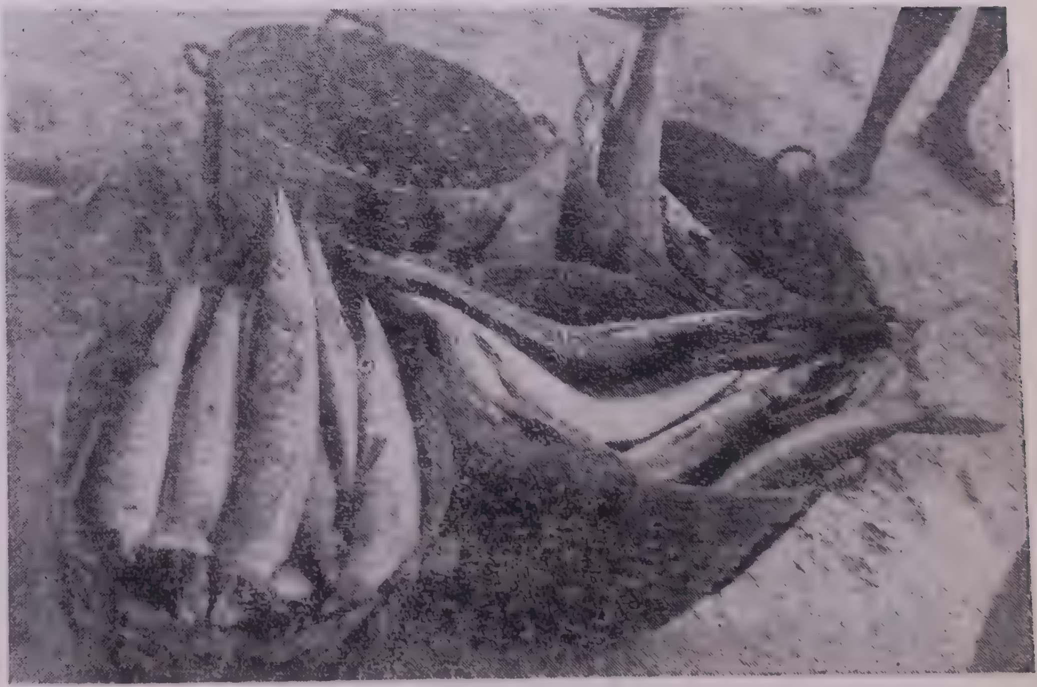

Fig. 6. *Sphyraena* spp. bound for the market.

Table 1. *Estimated catch of fishes by catamarans with hooks and line at Calicut during* 1986

Species	Catch (kg) November 1986	Catch (kg) December 1986	Length range (cm)	Average catch per trip (kg)	Species composition %
Scomberomorus commerson	15,540	27,668	72–152	11.09	45.3
Sphyraena spp.	11,000	33,596	51–92	10.41	46.8
Rachycentron canadus	1,835	2,899	132–150	1.25	5.0
Sepia pharaonis	1,125	1,712	19–26	0.75	2.9
Total	29,600	65,875			

The hooks along with the bait are tied to a monofilament of 1 mm thickness and released as the catamaran sails. The commonly occurring fishes such as oil sardine, mackerel, and *Stolephorus* sp. are used as baits. Usually fishes with bright colouration are preferred.

The catamarans are launched in the morning and they return at about 1600 hrs. They take about three hours to reach the fishing grounds and almost the same time for the return journey. The actual fishing period will be about 4–5 hours. The northeast wind is utilised for sailing.

At Calicut during the present observations the catamaran fishermen landed their catches from the last week of October to December, 1986. The fishing was mainly done along the rocky beds about 12 to 15 km away from the shore at a depth of 20-30 m. These areas proved to be a rich fishing ground for quality fishes like *Scomberomorus commerson, Sphyraena spp., Rachycentron canadus* and *Sepia pharaonis.* The average catch per trip was 23.5 kg for the period.

It may be pointed out that though the local gill net fishermen do not get good catches during this season, the hooks and line fishermen obtain fairly good catch (Table 1, Figs. 4, 5 & 6). This indicates scope for diversification of craft and gear in the area during this season. But, the catamaran fishermen had to leave the place before the end of the season as the local gill net fishermen objected to their fishing.

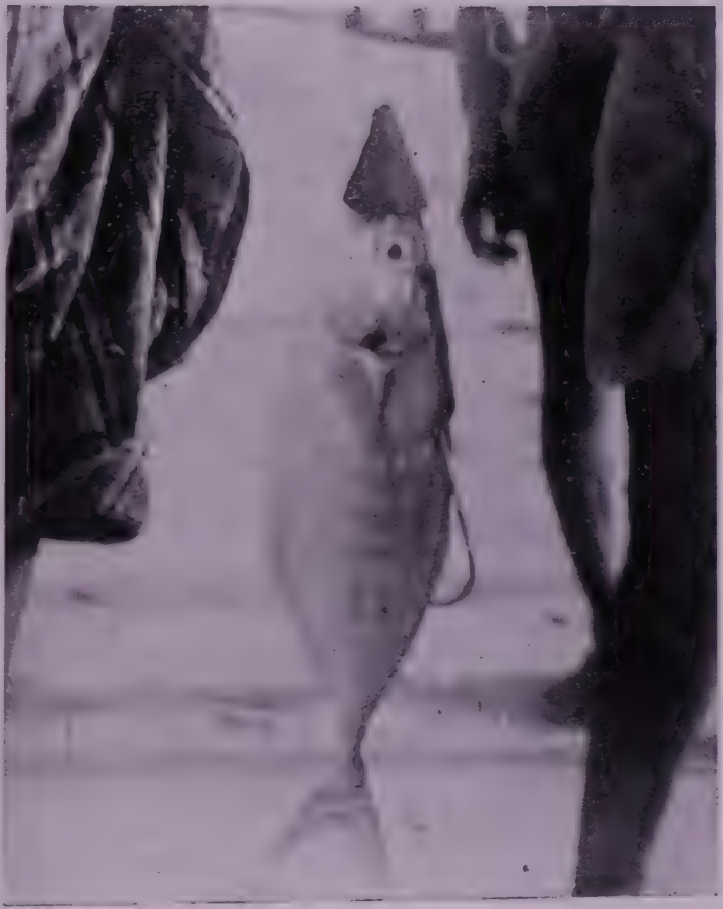

Fig. 3. Hook with bait fish.

Edited by Dr. K. J. Mathew, Mr. I. David Raj and Mr. G. S. D. Selvaraj. Published by Dr. K. J. Mathew on behalf of the Director Central Marine Fisheries Research Institute, Cochin-682 031. Printed at PAICO, Cochin–31.

MARINE FISHERIES INFORMATION SERVICE

8/9/89

No. 84
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Technical and Extension Series

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
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Abbreviation - *Mar. Fish. Infor. Serv., T & E Ser.*, No. **84**: 1988

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3. Olive ridleys landed at Pamban reported
4. Phytoplankton blooms along the Indian coasts — some highlights

Front cover photo:

Newly hatched larva of cat fish, *Osteogeneiosus militaris* taken out from the mouth of a male brooder.

Back cover photo:

A view of the Tuticorin Fisheries Harbour.

MARINE FISH CALENDAR

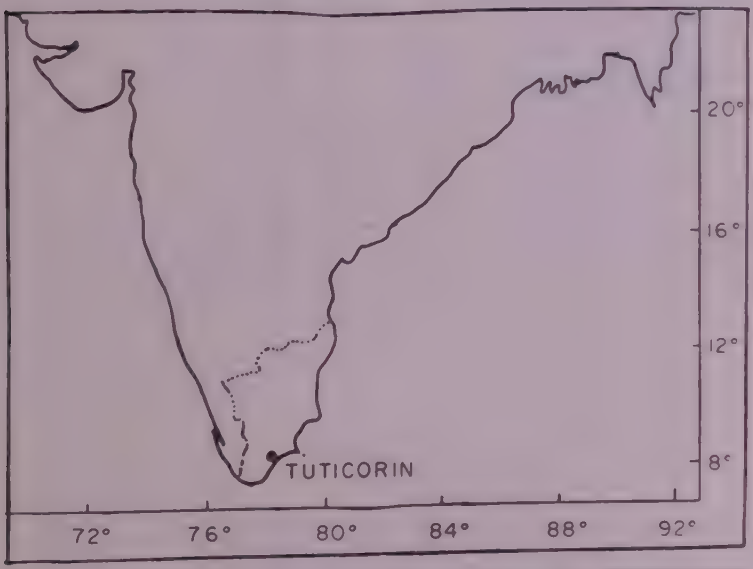
VI. TUTICORIN*

S. Mahadevan, P. Sam Bennet, K.M.S. Ameer Hamsa and H. Mohamad Kasim
Tuticorin Research Centre of CMFRI, Tuticorin

Introduction

Tuticorin is one of the well known, age old, fishery ports of India especially by virtue of the production of valuable, good quality, natural pearls and chanks in addition to marine fish production. Early in the 1911–'15 period the marine fish production here was to the tune of 663,592 pounds (296.3 tonnes) fetching an amount of Rs. 46,929. The fishermen strength was 520 who operated conventional 'valavalai', 'kolavalai', 'madivalai', offshore lining, inshore lining, trolling and other minor nets with the traditional fishing crafts like Tuticorin type of plank built boats called 'Vallam' and 'catamarans'. Percentage composition of important fisheries was ribbon fishes (34.3%), sardines (10.9%), jew fishes (9.5%), perches (8.8%), rock cods (5.8%), seer fishes (3.9%), sea breams (3.8%), sharks and rays (3.7%), red mullets (2.4%), anchovies (2.3%) *etc.*

Towards 1960 a vast transformation occurred in the fishing industry. As the historical pearl fishery of 1955–'61 almost waned into non-existence and the chank fishery being the monopoly of the State Government, fishing for different marine fish took an impetus resulting in a gradual change in the pattern of fishing with the introduction of high efficiency fishing materials like nylon nets and HDP twines in places of conventional hemp and cotton and linen yarns. In 1955–'56 period the total marine fish landing in Tuticorin was 35,000 maunds (392 t) caught by 'kolavalai', Dunlop twine nets, hand lines, R.C. lines, 'valavalai', 'madivalai', whiffing and long lines. During 1964–'65 and 1965-'66, the landing was 752.2 and 1,213.6 t respectively. Of this lesser sardines alone constituted the bulk of the catch accounting for 12.1%. Next in importance were the Indian sprats (9.6%), sea breams (6.7%), rock cods (6.7%), anchovies (6.4%) and seer fish (5.9%). There were distinct seasons for seerfish, tunnies, barracuda and carangid fisheries by troll lines (June – September). Hand lining for serranids, lutianids and lethrinids was brisk till March commencing from October.



Post 1970 period brought about a significant change in the quality and quantity of landings. New dimensions were introduced by seasonal prawn fishing by mechanised boats during July–October. On an average, 240 t of prawns and 1,650 t of fish were landed during early seventies by the mechanised trawlers in addition to 4,200 t landed by traditional fishing crafts. Drift nets landed 61% of the traditional catch, set gill nets 19.5%, line fishing 18.6% and seines 0.9%. In all, 973 net fishermen and 240 line fishermen were in the fishing activity.

Consequent to the improvement in the efficiency and longevity of the fishing gears by the introduction of synthetic fishing materials and prolific expansion of the mechanised trawlers, the artisanal and subsistence fishery metamorphosed into small-scale fishing industry. The construction of minor fishing harbour and interest shown by Kerala fish exporters served as a fillip towards the intensification of fishing activity. The important marine fishery resources of the region are (i) pelagic fishery resources such as clupeids (lesser sardines, Hilsa, Chirocentridae, *etc.*), seer fish, tuna, barracudas, sharks, anchovies, carangids, belones, bill fishes, *etc.*, (ii) Major demersal resources namely perches (lethrinids, rock cods, snappers, *scolopsis etc.*, sciaenids, nemipterids, silver bellies, *Thrissocles*, cat fish, pomfrets and rays, (iii) molluscan fishery resources like chanks, pearl oysters, edible oysters, squids, cuttle fishes, octopuses *etc.*, (iv) crustacean resources comprising of prawns, lobsters, and crabs and (v) seaweed resources.

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* Consolidated by N. Gopinatha Menon and K. Balachandran, CMFRI, Cochin.

Present assessment of fishery resources reveals that in a year 19,850 t of fish are landed by trawlers and 9,275 t by traditional fishing units. Silver bellies are the most dominant in trawl net catches constituting 2,900 t and the important species are *Leiognathus bindus, L. dussumieri* and *Secutor insidiator*. Lesser sardines comprising 2,250 t are constituted by *Sardinella fimbriata, S. gibbosa, S. albella* and *S. sirm*, and are landed mostly by drift gill net called 'Chalai valai'. The king seer *Scomberomorus commerson* forms not less than 90% of total seer fish catch and the rest by the streaked seer, *S. lineolatus* and spotted seer, *S. guttatus*. This resource is exploited mostly by drift gill nets, hand lines, long lines, trolling and to some extent by trawlers. The annual average catch of seer fish is 374 t. Though seer fish occur throughout the year the peak period of abundance coincides with the tuna season during July – September. *Auxis thazard, Euthynnus affinis, Sarda orientalis* and *Thunnus tonggol* support fishery of tuna and annually 502 t are landed. Perches of the area are lethrinids, *Epinephelus* spp. *Diagramma* spp. *Drepane* spp. serranids, *Scolopsis* spp., *Pomadasys* spp., *Nemipterus* spp. *etc.* The last three groups along with lethrinids are landed in good quantity by trawlers and the bigger perches are landed by drift gill nets and hooks and line. On an average 5,712 t of perches are landed in a year. *Sphyraena obtusata* is landed abundantly by trawlers from inshore water, whereas from deeper waters drift gillnets and hooks and line land *S. jello* and *S. picuda* and the annual catch of barracuda is to the tune of 685 tonnes.

The once popular shore-seine fishing which was one of the important gears for landing shore hugging coastal fishes including lesser sardines has almost vanished from this region following the intensification of mechanised fishing. Over the two decades, mechanised fishing has changed not only the fishing pattern but also the constituent catches. The progress of fishing industry can still be augmented by motorising the plank built boats and 'catamarans'. As early as in 1958, Tuticorin type 'vallam' was recognised by FAO as suitable for motorization which is now fast catching up as more and more 'vallams' and even 'catamarans' are being motorized. In addition to this, the introduction of high opening bottom trawl for pair trawling operations through FAO sponsored Bay of Bengal Programme (BOBP) has induced greater interest among the fishermen and already on an average ten pairs of trawlers are engaged in this new type of fishing. The catch is constituted mostly of valuable large size quality fishes like lethrinids, rock cods, snappers, seer fish, pomfrets, horse mackerel and carangids. Introduction of such new dimensions into fishing coupled with the higher rate of yield/sq. nautical mile of this water especially of demersal resources is bound to revolutionise the fishing pattern and enhance the marine fish productions in good proportion.

CARANGIDAE

Popular English Name : Trevally/Scad
Vernacular Name (Tamil) : 'Parai'
Annual average catch : 736.1 t
Percentage in total catch : 2.5
Fishing methods and their contribution : Trawl net : 2.49%
Drift net : 0.03 %
Period of occurrence : Aug. – Feb.
Depth of occurrence : 20 – 50 m

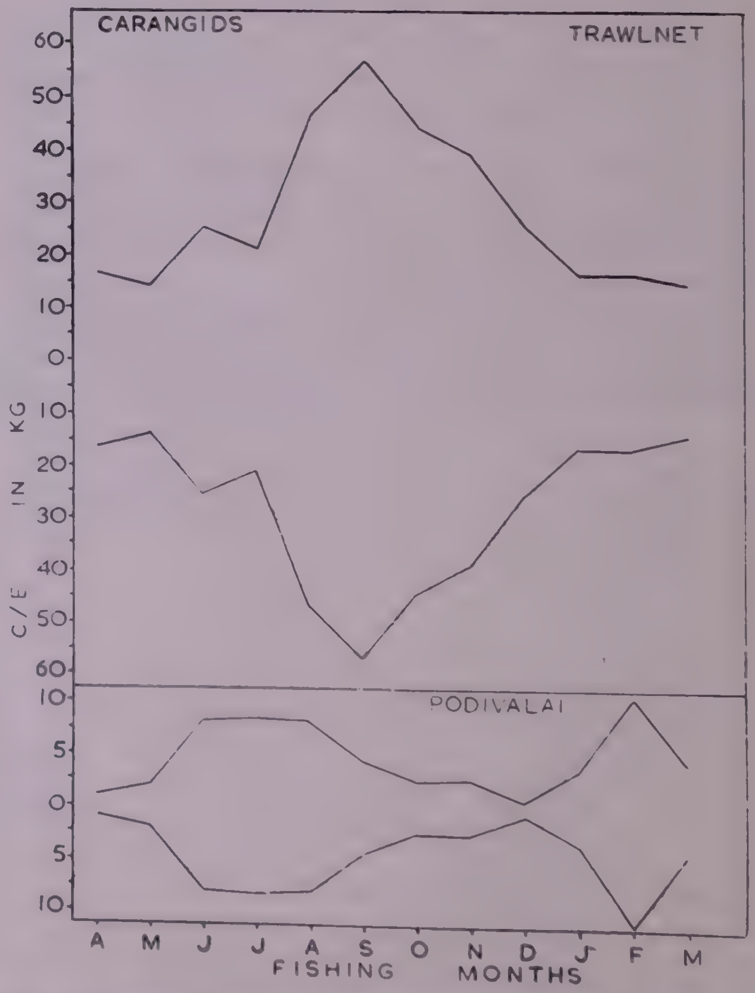

Fig. 1. Seasonal abundance of carangids in trawling and drift gill net grounds.

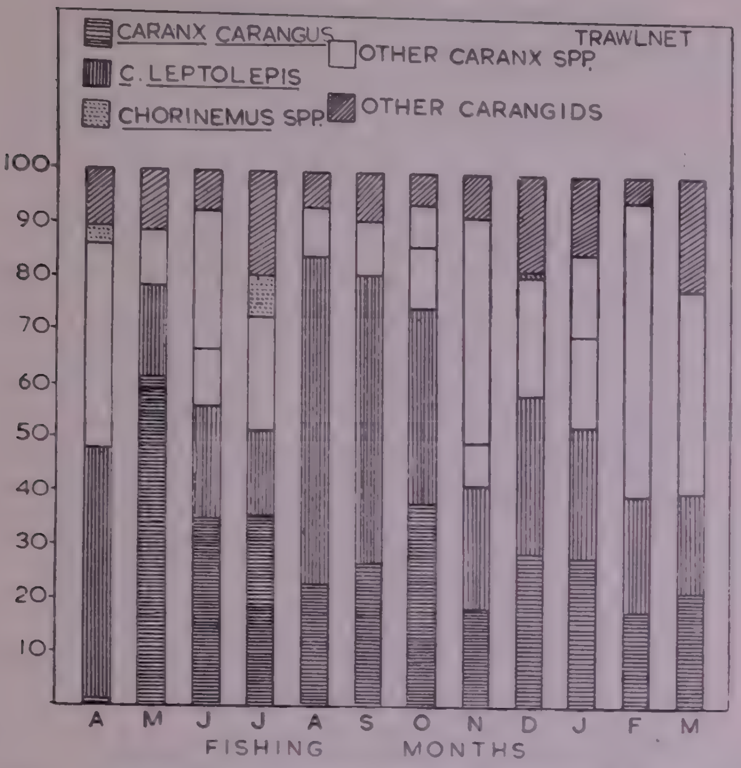

Fig. 2. Monthly species composition of carangids landed by trawlers.

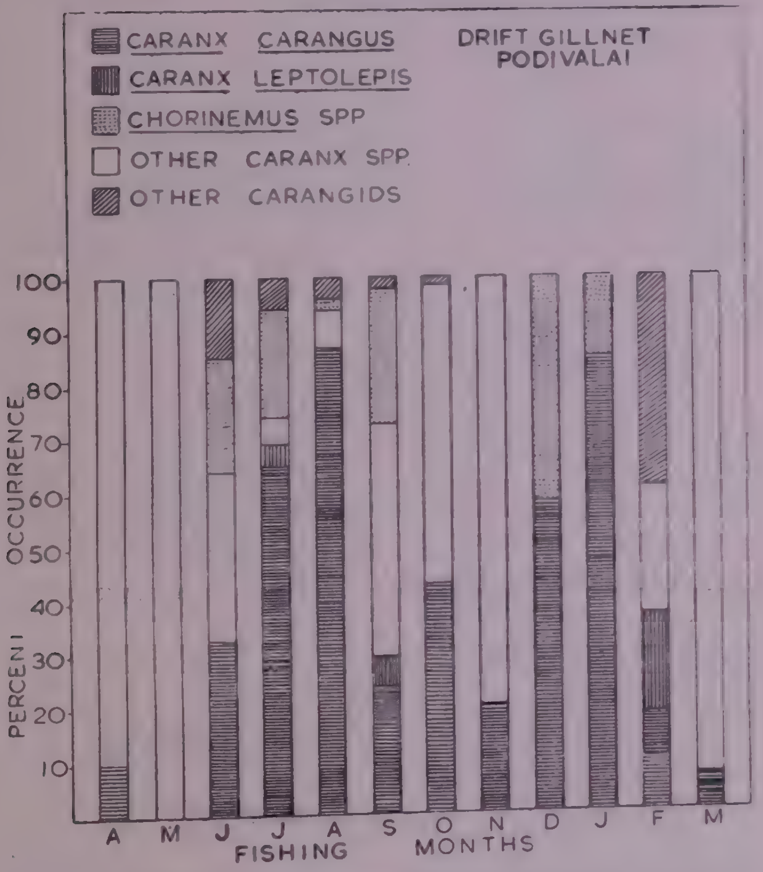

Fig. 3. Monthly species composition of carangids landed by drift gill net.

SCOMBRIDAE

Popular English Name : Seer fish
Vernacular Name (Tamil) : 'Neimeen'/'Vanjiran'/'Cheela'
Annual average catch : 374.4 t
Percentage in total catch : 1.3
Fishing methods and their contribution : Drift gill net : 0.7%
Trawl net : 0.4%
Hooks & line : 0.2%

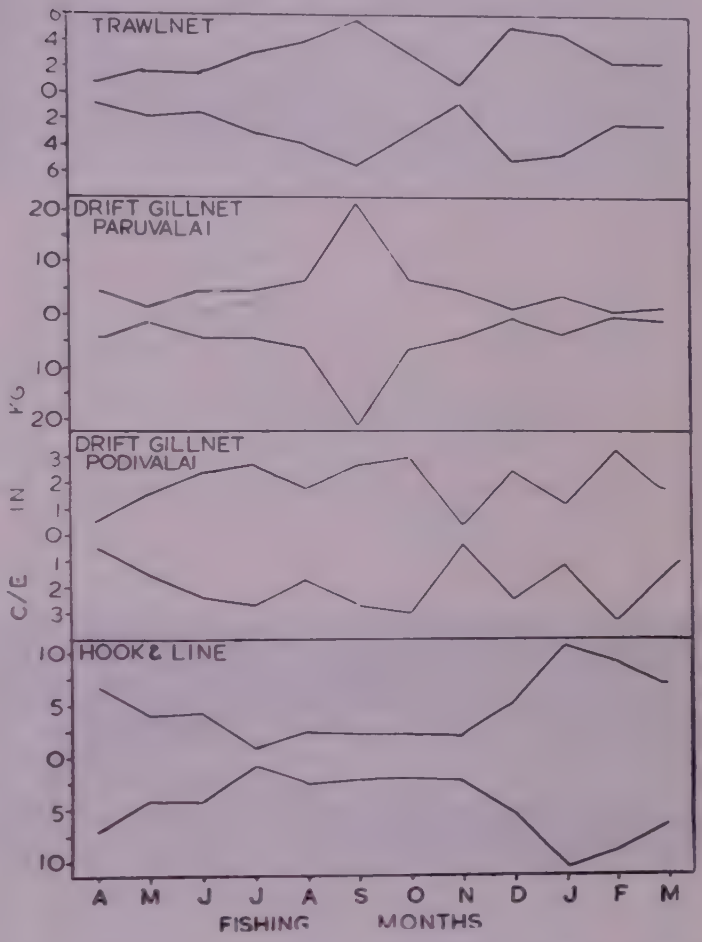

Fig. 4. Seasonal abundance of seer fishes in different fishing grounds.

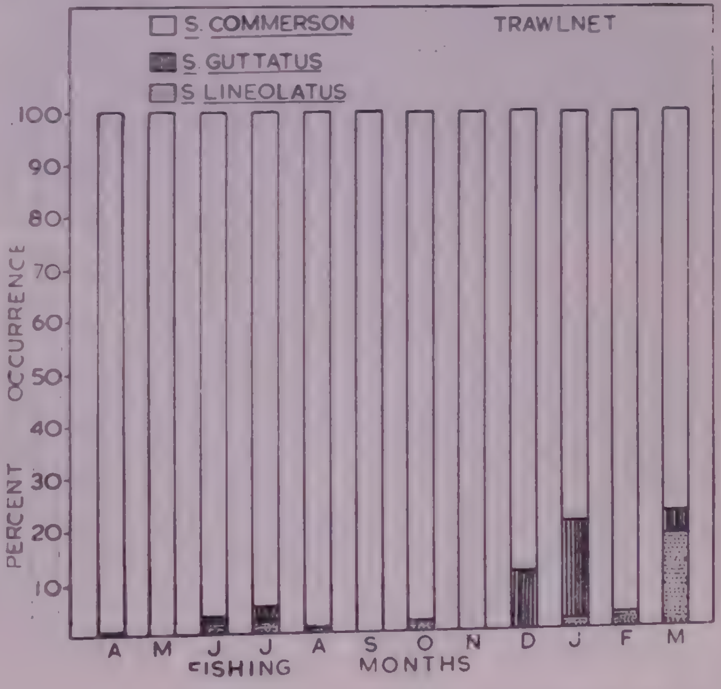

Fig. 5. Monthly species composition of seer fish landed by trawlers.

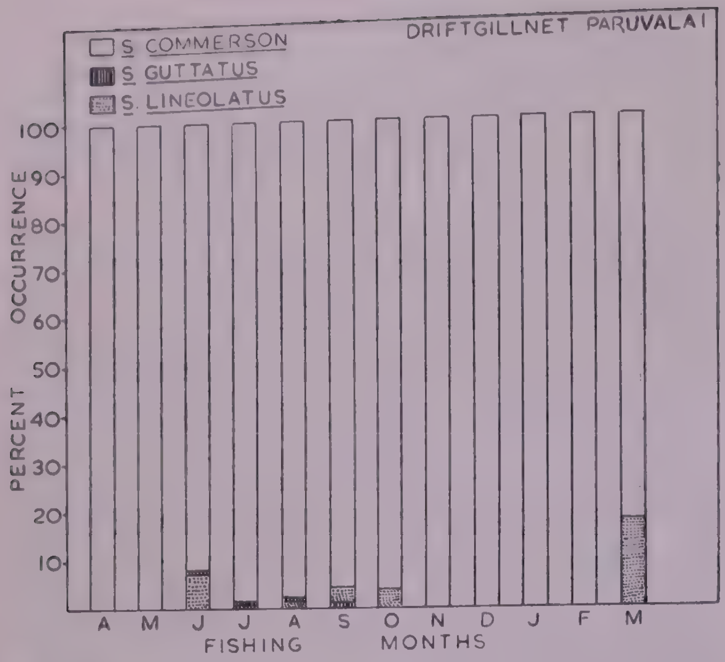

Fig. 6. Monthly species composition of seer fish landed by drift gill net (Paruvalai).

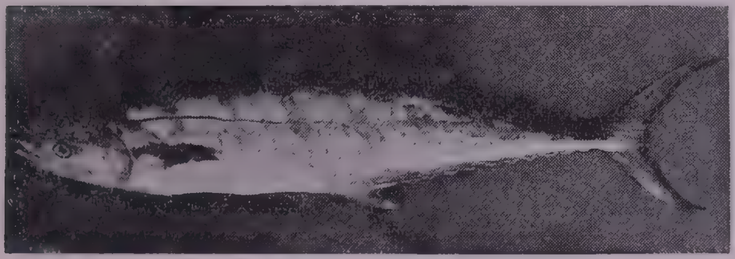

Fig. 7. *Scomberomorus commerson.*

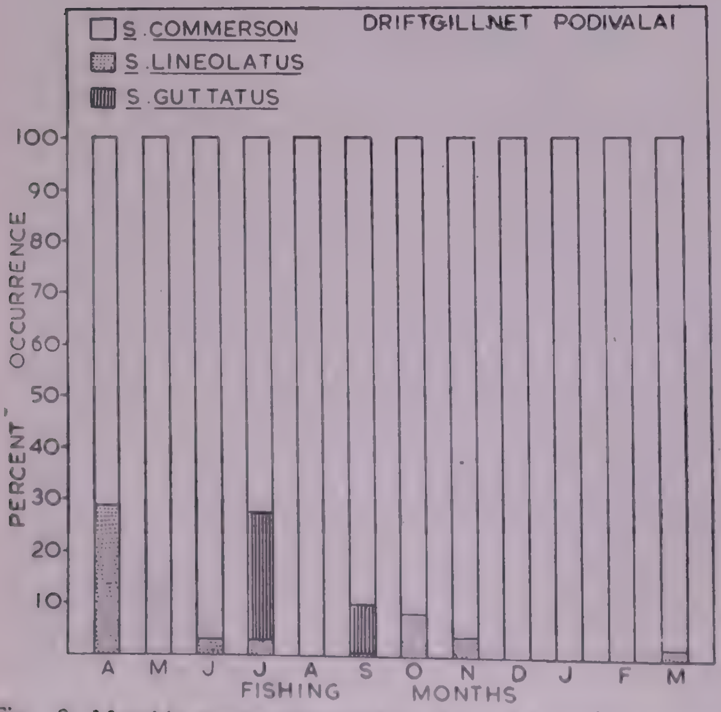

Fig. 8. Monthly species composition of seer fish landed by drift gill net (Paruvalai).

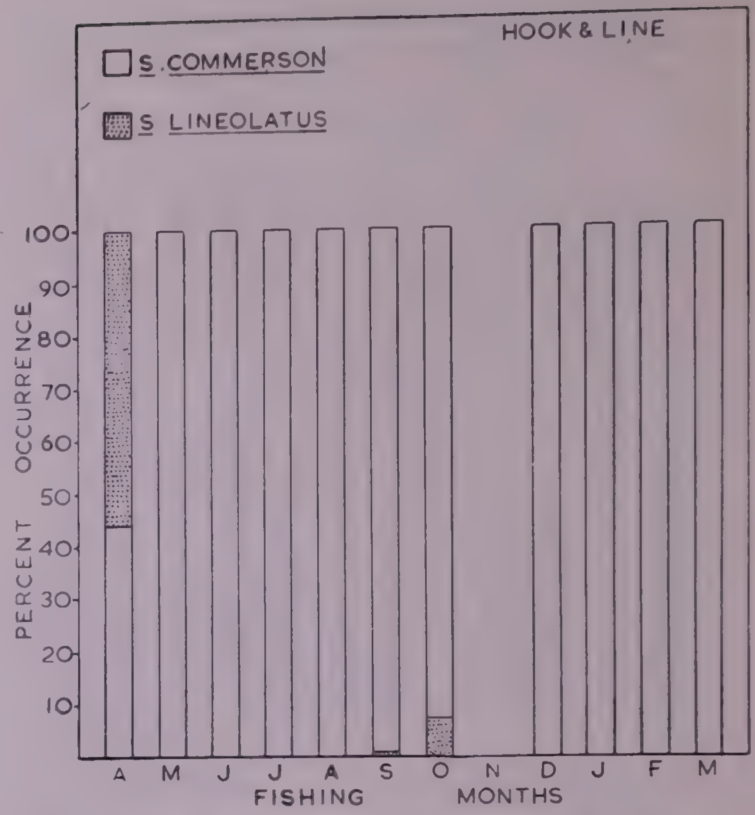

Fig. 9. Monthly species composition of seer fish landed by hook and line.

Scientific Name : *Scomberomorus commerson*
Vernacular Name : 'Nettayan'/'Cheela'
Gear : Drift gill net/Hooks and line/Trawl net
Percentage in the catch of the group : Drift net ('Paruvalai') : 96.2
Drift net ('Podivalai') : 92.7
Hooks & line : 94.2
Trawl net : 92.4
Peak period of occurrence : Jun. – Oct. and Jan.–Mar.
Depth of occurrence : 20 – 60 m
Length range in commercial fishery : 100 – 1,400 mm
Size at first maturity : —
Spawning season : Nov. – Jan.

TUNAS & BILL FISHES

Popular English Name : Tuna
Vernacular Name (Tamil) : 'Surai'
Annual average catch : 502.4 t
Percentage in total catch : 1.7
Fishing methods and their contribution : Drift gill net : 1.7%

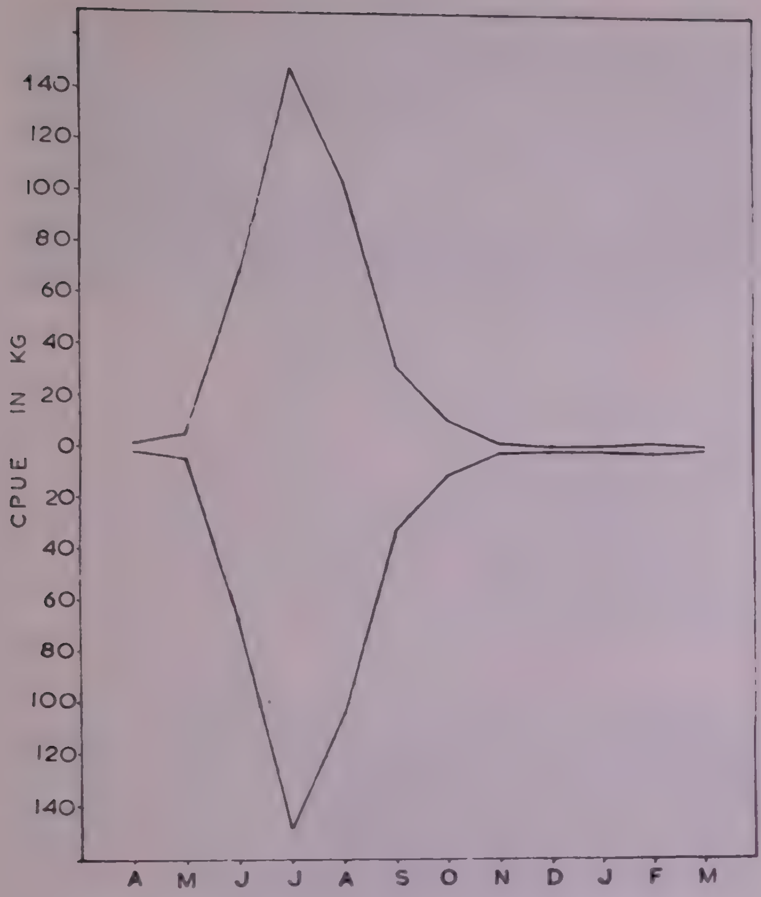

Fig. 10. Seasonal abundance of tuna and bill fishes.

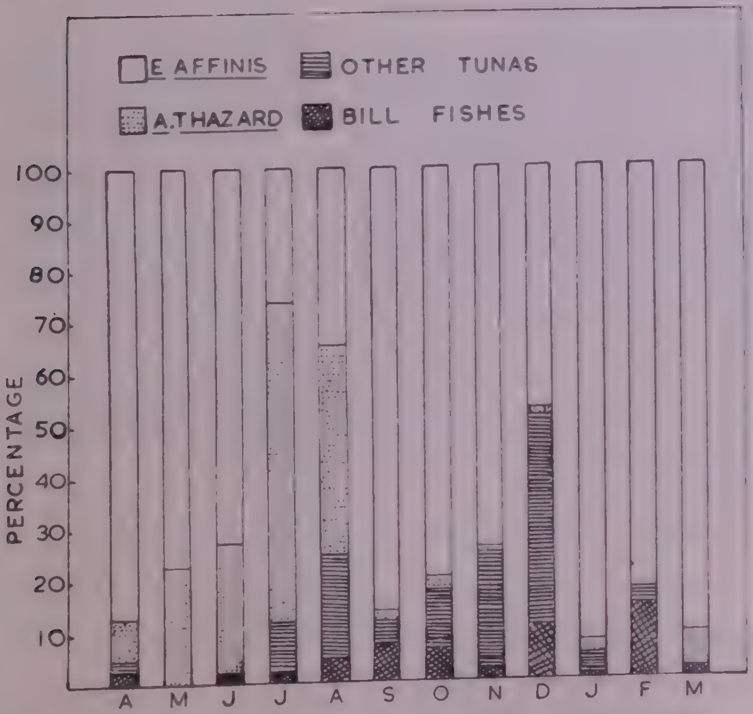

Fig. 11. Monthly species composition of tuna and bill fishes landed by drift gill net.

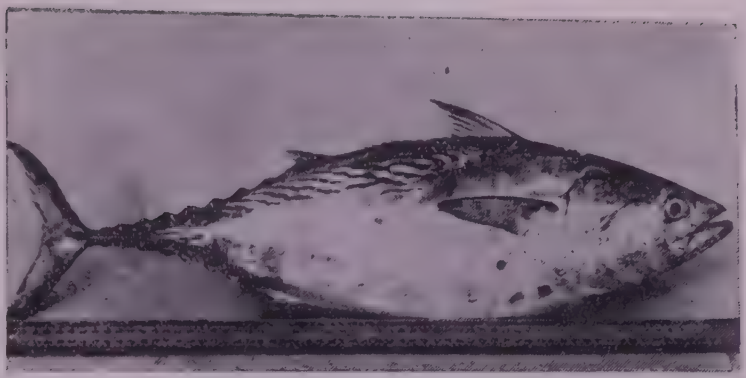

Fig. 12. *Euthynnus affinis.*

Scientific Name : *Euthynnus affinis*
Vernacular Name : 'Parunsurai'
Gear : Drift gill net
Percentage in the catch of the group : 70.7
Peak period of occurrence : Jun. – Aug.
Depth of occurrence : 30 – 40 m
Length range in commercial fishery : 440 – 600 mm
Size at first maturity : 480 mm
Spawning season : Sep. – Nov.

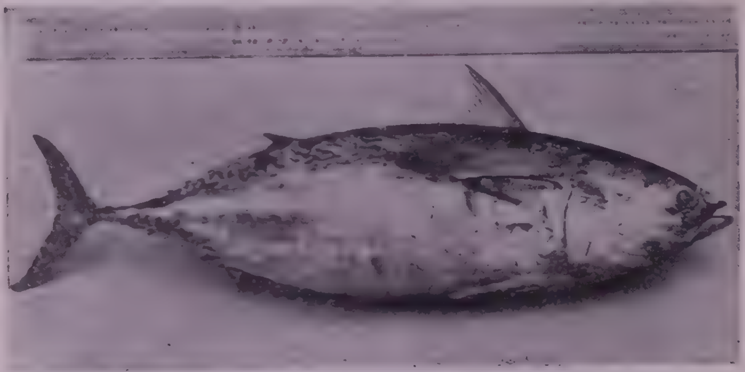

Fig. 13. *Auxis thazard.*

Scientific Name : *Auxis thazard*
Vernacular Name : 'Elisurai'
Gear : Drift gill net
Percentage in the catch of the group : 14.6
Peak period of occurrence : Jun. – Aug.
Depth of occurrence : 30 – 40 m
Length range in commercial fishery : 300 – 420 mm
Size at first maturity : 300 mm
Spawning season : Sep. – Mar.

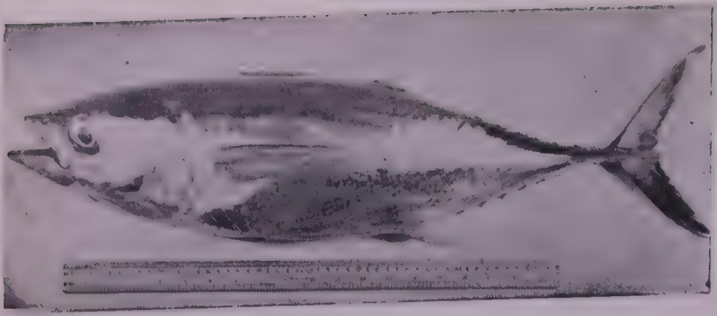

Fig. 14. *Thunnus albacares.*

Scientific Name : *Thunnus albacares*
Vernacular Name : 'Keelavalai'
Gear : Drift gill net
Percentage in the catch of the group : 7.0
Peak period of occurrence : —
Depth of occurrence : 30 - 40 m
Length range in commercial fishery : —
Size at first maturity : —
Spawning season : —

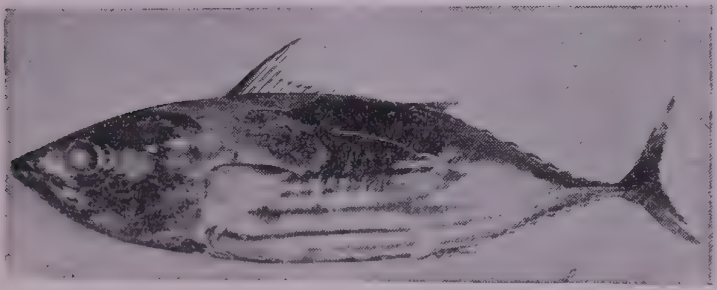

Fig. 15. *Katsuwonus pelamis.*

Scientific Name : *Katsuwonus pelamis*
Vernacular Name : 'Varisurai'
Gear : Drift gill net
Percentage in the catch of the group : 1.1
Peak period of occurrence : —
Depth of occurrence : 30 – 40 m
Length range in commercial fishery : —
Size at first maturity : —
Spawning season : —

Scientific Name : *Thunnus tonggol*
Vernacular Name : 'Eutavalai'
Gear : Drift gill net
Percentage in the catch of the group : 0.7
Peak period of occurrence : —
Depth of occurrence : 30 - 40 m
Length range in commercial fishery : —
Size at first maturity : —
Spawning season : —

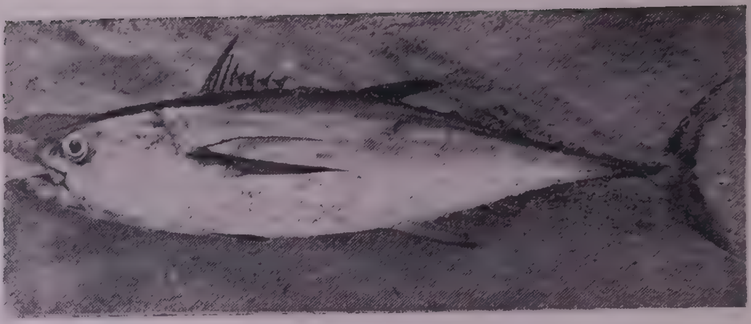

Fig. 16. *Thunnus tonggol.*

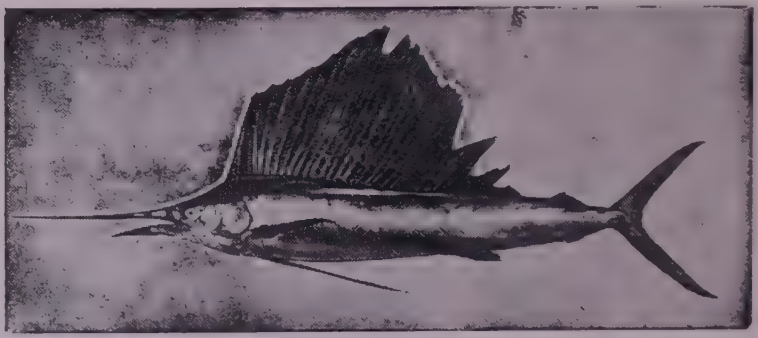

Fig. 17. *Istiophorus platypterus.*

Scientific Name : *Istiophorus platypterus*
Vernacular Name : 'Kopperakkulla'
Gear : Drift gill net
Percentage in the catch of the group : 4.1
Peak period of occurrence : —
Depth of occurrence : 30 – 40 m
Length range in commercial fishery : —
Size at first maturity : —
Spawning season : —

CLUPEIDAE

Popular English Name : Sardine
Vernacular Name (Tamil) : 'Salai'/'Choodai'/ 'Keerimeen chalai'/ 'Paisalai'
Annual average catch : 3,855.2 t
Percentage in total catch : 13.2
Fishing methods and their contribution : Gill net : 13.2%

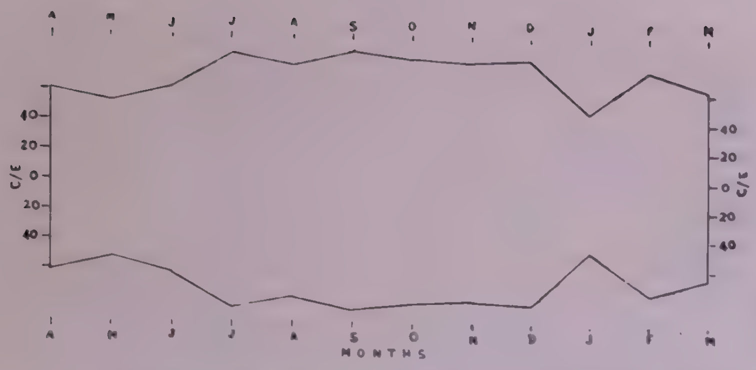

Fig. 18. Seasonal abundance of sardines by indigenous fishing units.

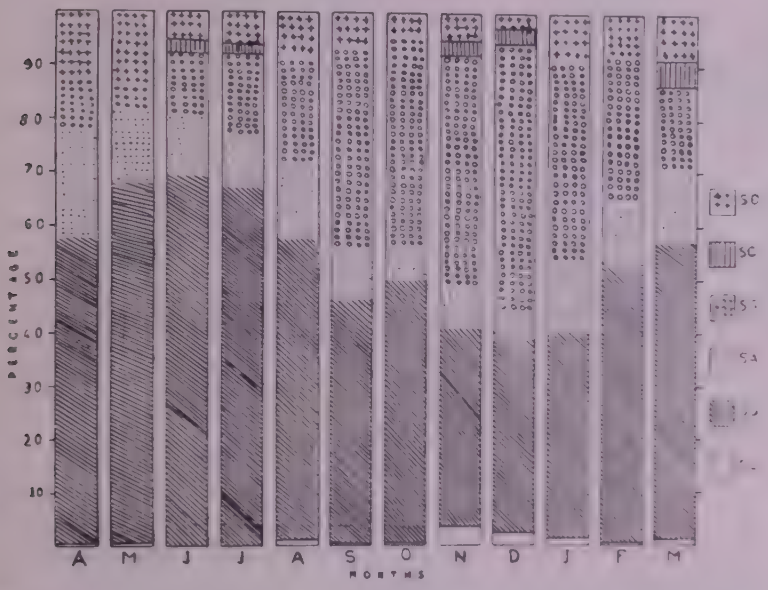

Fig. 19. Monthly species composition of sardines landed by indigenous fishing units (SD – *Sardinella dayi*; SC – *S. clupeoides*; SS – *S. sirm*; SA – *S. albella*; SG – *S. gibbosa* and SL – *S. longiceps*).

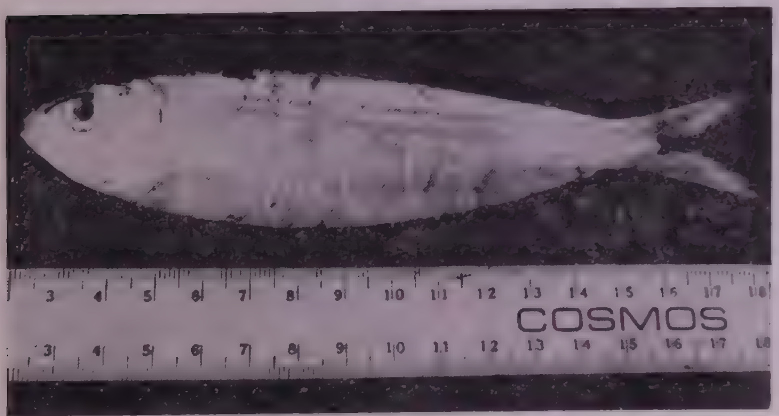

Fig. 20. *Sardinella gibbosa*.

Scientific Name	:	*Sardinella gibbosa*
Vernacular Name	:	'Salai'
Gear	:	Gill net
Percentage in the catch of the group	:	52.1
Peak period of occurrence	:	May – Jul.
Depth of occurrence	:	5 – 10 m
Length range in commercial fishery	:	100 – 180 mm
Size at first maturity	:	120 mm
Spawning season	:	June

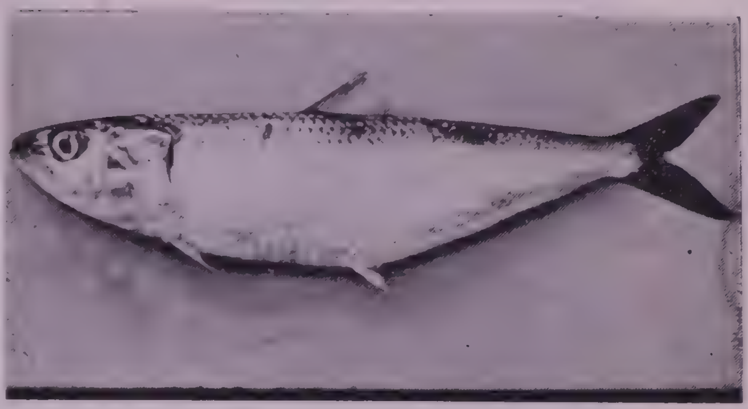

Fig. 21. *Sardinella longiceps.*

Scientific Name	:	*Sardinella longiceps*
Vernacular Name	:	'Peisalai'
Gear	:	Gill net
Percentage in the catch of the group	:	0.9
Peak period of occurrence	:	Nov. – Dec.
Depth of occurrence	:	5 – 10 m
Length range in commercial fishery	:	120 – 165 mm
Size at first maturity	:	140 mm
Spawning season	:	March

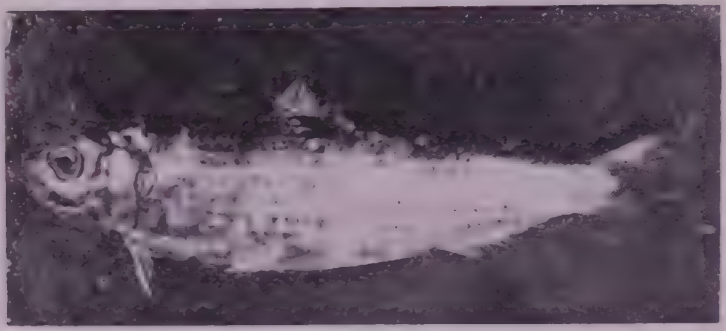

Fig. 22. *Sardinella dayi.*

Scientific Name	:	*Sardinella dayi*
Vernacular Name	:	'Choodai'
Gear	:	Gill net
Percentage in the catch of the group	:	7.3
Peak period of occurrence	:	Apr. – May
Depth of occurrence	:	5 – 10 m
Length range in commercial fishery	:	100 – 165 mm
Size at first maturity	:	120 mm
Spawning season	:	Feb.

Scientific Name : *Sardinella sirm*
Vernacular Name : 'Karimeen chalai'
Gear : Gill net
Percentage in the catch of the group : 27.8
Peak period of occurrence : Nov. – Dec.
Depth of occurrence : 5 – 10 m
Length range in commercial fishery : 145 – 220 mm
Size at first maturity : 170 mm
Spawning season : August

Scientific Name : *Sardinella albella*
Vernacular Name : 'Choodai'
Gear : Gill net
Percentage in the catch of the group : 10.8
Peak period of occurrence : April
Depth of occurrence : 5 – 10 m
Length range in commercial fishery : 100 – 165 mm
Size at first maturity : 110 mm
Spawning season : June

ON THE AVAILABILITY OF TUNA LIVE-BAIT FISHES AT VIZHINJAM*

Introduction

The success of tuna fishing by pole and line depends mainly on the availability of live-bait fishes. About 230 species of fishes representing 34 families are being used as live-baits in the pole and line fishing to capture Skipjack tuna throughout the Pacific, Atlantic and Indian Oceans with varying degrees of success and many other species are no doubt employed as live-bait but not reported in literature. In India an acute shortage of live-bait fishes has been faced in recent times in the Lakshadweep waters. In view of this a preliminary survey was made at Vizhinjam from May, 1986 to April, 1987 to find out their availability, and a brief report is given here with a view to suggesting future programme to be undertaken from this area.

Characteristics of an ideal live-bait

The most desirable characteristics of a good bait fish are: 1) highly reflective lateral surface, (2) surface swimming with rapid erratic motion, (3) tendency to return to the vessels when broadcast, (4) length below 15 cm, preferably 6–8 cm with elongate body, (5) abundance, availability to the fishery and the ease with which it can be handled and (6) hardiness and survival for extended periods in captivity.

Bait fishes available at Vizhinjam

Vizhinjam (8°22′30″ N and 76° 59′ 15″ E) falling almost in the same meridian as that of Minicoy, offers a variety of small sized fishes having the above mentioned characteristics of bait fishes. Some forms like *Stolephorus* spp., *Sardinella* spp., and post larvae and juveniles ('Nonnavu') of other commercially important groups of fishes have a regular fishery in this area. Percoid fishes represented by families Pomacentridae, Apogonidae and Labridae are encountered in this area mainly in the 'paar' (coral) regions, but they are not represented in appreciable quantities in the commercial landings and hence species composition and catch data are not given in this report. Bait fishes available at Vizhinjam with their seasons of occurrence are given in Table 1.

Among the fishes listed in Table 1 the following forms namely *Caesio caerulaureus, Dipterygonotus leucogrammicus, Labroides dimidiatus, Pomacentrus pavo, Apogon sangiensis, Chromis caeruleus* and *Pranesus duodecimalis* are used as live-baits in the pole and line fishing in the Lakshadweep area. Of these *Caesio caerulaureus* is available in its juvenile stage ranging in sizes from 89–145 mm during February–March in the boat seine catches at Vizhinjam. *Dipterygonotus leucogrammicus* is available during March in sizes ranging from 43–57 mm, similar to that of the size available

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* Prepared by P.S.B.R. James, CMFRI, Cochin and S. Lazarus and C. S. Gopinadha Pillai, VRC of CMFRI, Vizhinjam.

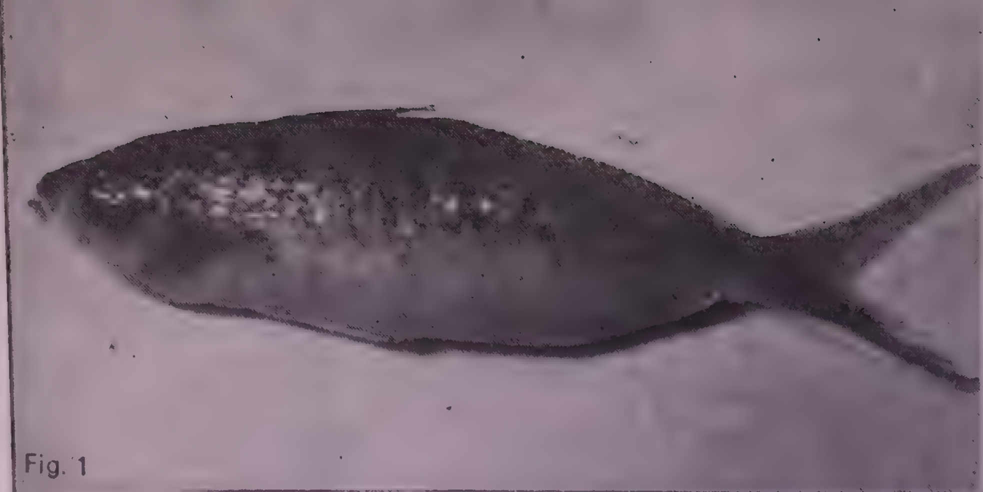


Fig. 1

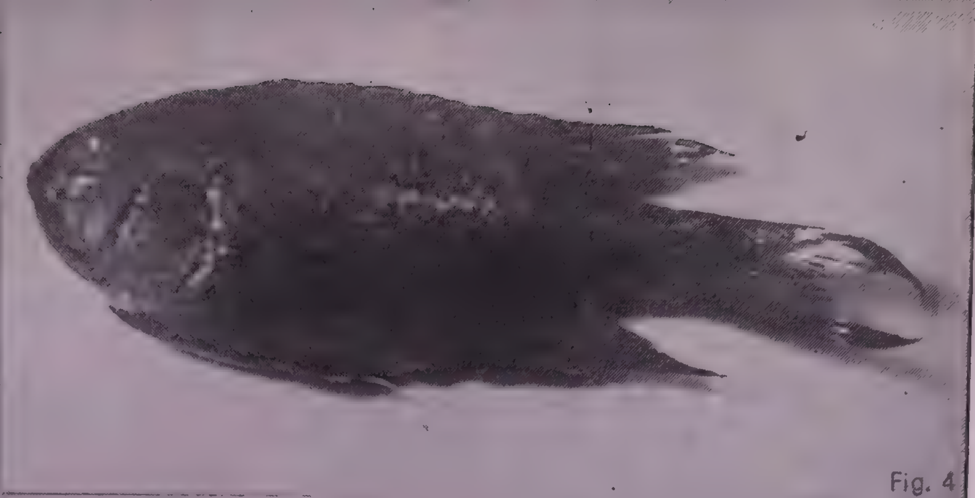
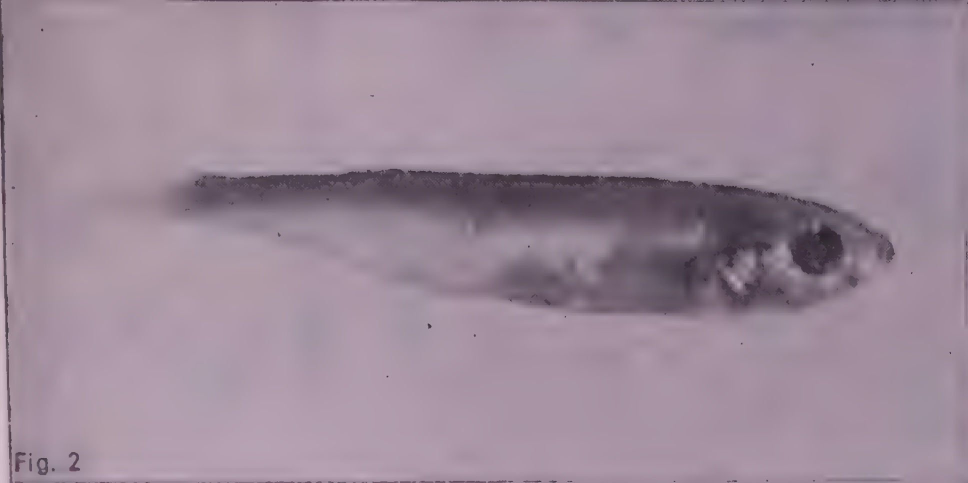


Fig. 4



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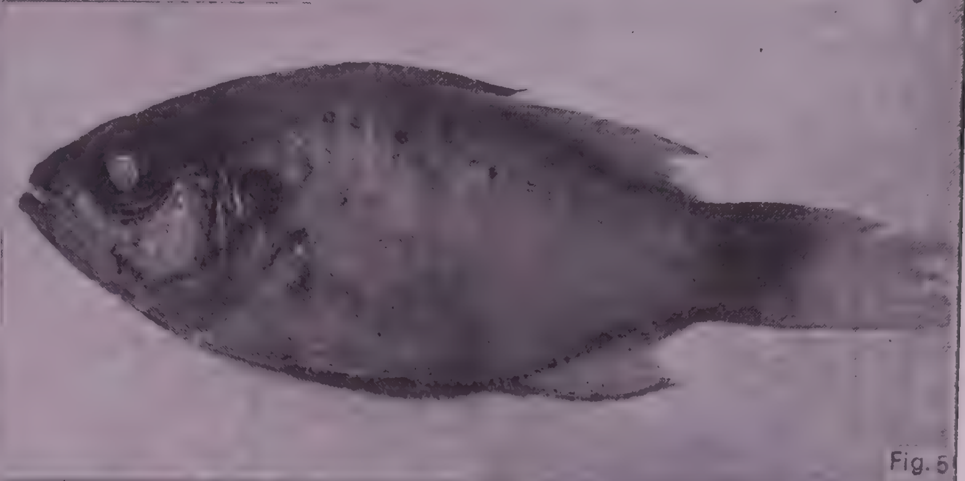
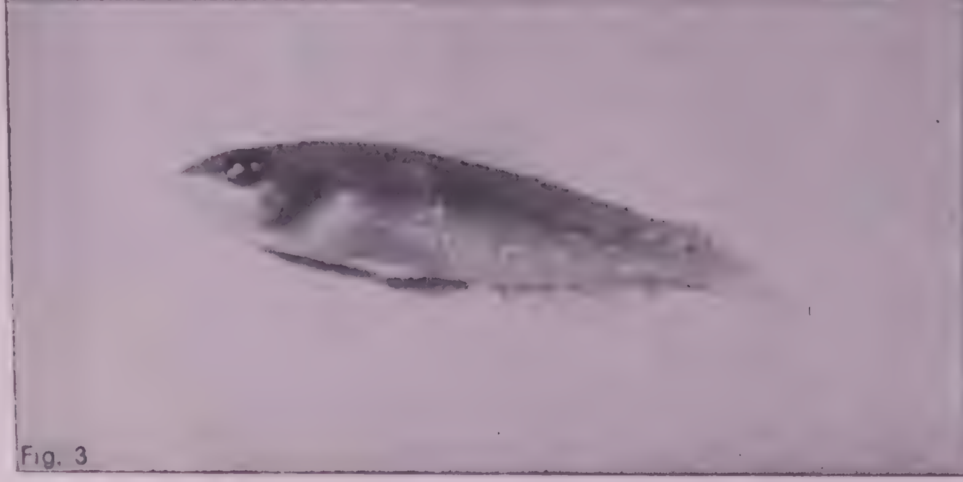


Fig. 5



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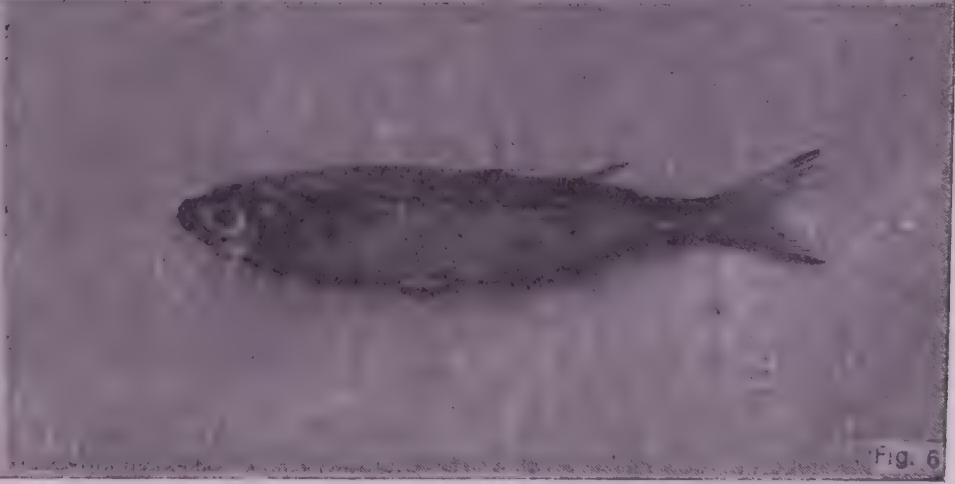

Fig. 6

Fig. 1. *Caesio caerulaureus*	114 mm (TL)
Fig. 2. *Dipterygonotus leucogrammicus*	56 mm (TL)
Fig. 3. *Labroides dimidiatus*	45 mm (TL)
Fig. 4. *Pomacentrus pavo*	91 mm (TL)
Fig. 5. *Apogon sangiensis*	110 mm (TL)
Fig. 6. *Pranesus duodecimalis*	105 mm (TL)

Table 1. *Bait fishes available at Vizhinjam and the seasons of their occurrence*

Family	Species	Size range (mm)	Season of occurrence
Caesiodidae	*Caesio caerulaureus*	85 – 145	January – March
Emmelichthyidae	*Dipterygonotus leucogrammicus*	43 – 57	March – April
Labridae	*Labroides dimidiatus*	35 – 45	February – March
Pomacentridae	*Pomacentrus pavo*	75 – 90	February – March
	Chromis caeruleus	115 – 122	January – March
Apogonidae	*Apogon sangiensis*	112 – 115	March – April
Atherinidae	*Pranesus duodecimalis*	25 – 76	April – October
Ambassidae	*Ambassis gymnocephalus*	20 – 88	October – February
Clupeidae	*Stolephorus spp.* (7 species)	10 – 140	April – October/December
	Sardinella spp. (5 species)	20 – 215	April – August and October – December

in the Lakshadweep area. Luther *et al.* (Symp. Coastal Aquaculture, 3: 861–875, 1984) reported that *Pranesus duodecimalis* occurs in large quantities in the Vizhinjam area during April to October. According to them this fish has a high rate of survival in captivity. Other types of live-bait fishes reported here occur in this area in stray numbers.

The glassy perch *Ambassis gymnocephalus,* has all the characters of a live-bait and is available in large quantities in this area right from the egg stage onwards. An attempt to transfer this fish to the Lakshadweep Island waters and to try them as bait for pole and line fishing for tuna appears to be worth considering.

Bait fish gears

Bait fishes are caught mainly by seine nets (boat seine and shore seine). They are also fished by gill nets and hooks and line ('Achil') at certain seasons. The juvenile fishes are caught by a small meshed shore seine called *'Nonna vala'*.

Remarks

The studies of Kuthalingam *et al. (Proc. Natl. Sem. Cage Pen culture,* 87–88, 1983) and Luther *et al.* (*op. cit.*, 1984) have given some idea about the survival rates of some of the bait fishes in captivity. However, collecting the bait fishes from the commercial catches and keeping them in floating cages seem to be a laborious task. So it is time to think about artificially breeding the important bait fishes by collecting the brood stock from the wild. In addition, surveys should be conducted in the nearby areas also to identify suitable resources of live-bait fishes and develop methods to transport and maintain the stock for later use in the tuna fishery. Attempts should also be made to identify alternate species which could be used as live-baits. *Ambassis gymnocephalus* is one such species which could be experimented with. The present study indicates that the species like *Caesio caerulaureus, Dipterygonotus leucogrammicus* and *Pranesus duodecimalis* deserve further studies.

OLIVE RIDLEYS LANDED AT PAMBAN REPORTED*

Landing of 7 and 6 Nos. of *Lepidochelys olivacea* on 7th & 9th January, 1988 respectively at Pamban caught in trawl net from the Gulf of Mannar off Dhanushkodi at a depth of 12–15 m has been reported. The carapace length of the turtles varied from 61 to 70 cm and the width from 55 to 62 cm.

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* Reported by C. Kasinathan, Mandapam Reg. Centre of CMFRI, Mandapam Camp.

PHYTOPLANKTON BLOOMS ALONG THE INDIAN COASTS–SOME HIGHLIGHTS*

Introduction

Blooms of plant origin are known to occur under various conditions in the inshore regions. These may take place, often with cyclical regularity in any particular area when some optimum conditions of temperature, salinity, sunlight, nutrients *etc.* prevail in the marine environment. The bloom usually takes place rather suddenly and may spread with amazing speed, sometimes changing the colour of the surface waters into red, green or hay colour. The blooms will be normally monotypic.

The most important factor for the phytoplankton blooms is the presence of high quantities of nutrients in the surface waters which may be due to the process of upwelling or run off from land. Thus it has been observed that the majority of blooms appear during monsoons or soon after.

The southwest coast of India is known for intense upwelling during the southwest monsoon period. During this period the nutrient rich subsurface water is brought to the surface, which provides congenial condition for high productivity at the primary level, sometimes leading to the flowering of certain species of phytoplankters.

Trichodesmium though totally non-toxic, can cause fish kills when it occurs in blooms by clogging the gills. Usually fish tend to avoid such thick blooms as these are not much favoured as food and ingested only accidentally. Destruction of corals can also take place due to the depletion of oxygen when thick dumps of *Trichodesmium* decompose.

The CMFRI has been continuously monitoring the pattern of productivity at the primary and secondary levels in the inshore fishing grounds at important fish landing centres along the coasts of India. During the course of these investigations phytoplankton blooms have been recorded regularly from the selected centres. The present article embodies a critical appraisal of the blooms observed at Karwar, Mangalore, Cochin, Vizhinjam, Tuticorin and Madras from 1982 to 1987.

Observations and results

Noctiluca miliaris, Coscinodiscus sp. and *Fragilaria oceanica* are the three common species which appear in blooms regularly. There are some other phytoplankters also which bloom occasionally at restricted areas. These include species of *Ceratium, Chaetoceros, Rhizosolenia, Biddulphia, Skeletonema, Thalassionema, Thalassiosira subtilis, Thalassiothrix* and *Trichodesmium.* The organisms which bloomed at various centres in different years under study are given in Table 1.

Noctiluca miliaris appeared in blooms in some place or other in all the years under consideration. The period of blooming of this species was found to be between August and April of every year except in Madras where it occurred in June, 1984 also. At Karwar during a two year period under observation, *N. miliaris* occurred in blooms in September, 1982. At Mangalore it occurred continuously for four months from November, 1986 to February, 1987. At Cochin though observations were on from 1984 onwards only, blooms of *N. miliaris* were seen in three months (February, March and June) in 1986 and April, 1987. At Vizhinjam, August to November was the period for the blooms of *Noctiluca.* Thus in 1982, the bloom occurred in October but in 1983, it was during August and September. Blooms were not observed during 1984 and 1985 but appeared again in November 1986. A striking peculiarity observed in the occurrence of blooms of *Noctiluca* was that while at Mangalore and Vizhinjam blooms appeared during November–December, in 1986 and November in 1987 respectively, at Cochin during some years the bloom took place in February, March and June. Thus it is seen that *Noctiluca,* as a rule, appears in blooms during the post monsoon and premonsoon seasons when the water temperature is comparatively high and required amounts of nutrients are present in the surface waters especially during the post monsoon period.

From Madras reports were received with regard to the blooms of *Ceratium* sp. in 1982 (May & June) and 1984 (April & May). However, from 1985 to 1987 flowering of this species had not been reported from Madras.

Blooms of *Coscinodiscus* sp. had been reported from the northern parts of the southwest coast of India namely Karwar and Mangalore and Madras on the

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* Prepared by K. J. Mathew, P. A. Thomas, Rani Mary George, K. G. Girijavallabhan, Pon. Siraimeetan, T. S. Naomi, K. Ramachandran Nair, Geetha Antony, G. Subramanya Bhat and M. Selvaraj, CMFRI, Cochin.

Table 1. *Details of occurrence of phytoplankton blooms at different centres during 1982 – '87*

Species		1982	1983	1984	1985	1986	1987
1. *Noctiluca miliaris*	Karwar	Sep.	—	No	No	No	No
	Mangalore	—	—	—	—	Nov., Dec.	Jan., Feb.
	Cochin	No	No	—	—	Feb., Mar., Jun.	Apr.
	Vizhinjam	Oct.	Aug., Sep.	—	—	Nov.	—
	Madras	Aug., Sep.	No	Jun.	—	—	—
2. *Ceratium* sp.	Madras	May, Jun.	No	Apr., May	—	—	—
3. *Coscinodiscus* sp.	Karwar	Jan., Dec.	Jan., Feb.	No	No	No	No
	Mangalore	—	Mar.	—	Nov.	Feb., Mar.	—
	Madras	—	No	Apr., Sep., Dec.	Jan.	—	—
4. *Fragilaria oceanica*	Cochin	No	No	Jul.	Jul.	Jul.	Jun., Aug.
	Vizhinjam	Jul.	—	—	Jun.	—	—
5. *Chaetoceros* sp.	Karwar	Feb.	—	No	No	No	No
	Vizhinjam	Aug.	—	—	—	—	—
6. *Rhizosolenia* sp.	Mangalore	—	—	—	Nov.	—	—
	Vizhinjam	—	—	—	Jun.	—	—
	Madras	May, Jun.	No	—	—	—	—
7. *Biddulphia* sp.	Mangalore	—	—	—	Nov.	—	—
8. *Skeletonema* sp.	Mangalore	—	Feb.	—	—	—	—
	Madras	Jun.	No	—	—	—	—
9. *Thalassionema* sp.	Vizhinjam	—	—	—	Jun.	—	—
10. *Thalassiosira subtilis*	Vizhinjam	—	—	—	—	—	Jun.
11. *Thalassiothrix* sp.	Madras	Apr.	No	—	—	—	—
12. *Trichodesmium* sp.	Tuticorin	—	—	—	Aug., Oct.	Aug.	Apr., May
	Madras	Jun.	No	Apr.	—	—	—

No = No observation.
— = Not present.

east coast. At Karwar it occurred during both the years of observation. In general November–March was the period of bloom for this species. During January and December in 1982 it appeared in blooms at Karwar. From December, 1982 the bloom continued up to March, 1983 at this centre. At Mangalore out of six years under consideration, the *Coscinodiscus* sp. was in bloom during 1983 (March), 1985 (November) and 1986 (February & March). On the east coast, the bloom took place in April, September and December in 1984 and January in 1985 in Madras. From the data obtained it could be seen that the period of bloom for *Coscinodiscus* sp. was almost the same as that of *Noctiluca miliaris* though they were not seen in blooms simultaneously in any year.

Fragilaria oceanica is a typical phytoplankton which appears in blooms during the monsoon season especially in the southern parts of the southwest coast of India. Ever since regular sampling started in Cochin, the species occurred in blooms in one of the months of June, July or August. While in 1984, '85 and '86 it occurred in dense blooms in July, in 1987 it was abundant during June and August. At Vizhinjam, however, *Fragilaria oceanica* was in bloom occasionally, in 1982 and 1985. But the phenomenon appeared in June in both the years.

Chaetoceros sp. was found in blooms at both Karwar and Vizhinjam in 1982. However, the period of occurrence was totally different, being in February at the former centre and August at the latter. Similarly, *Rhizosolenia* sp. was another species which was in bloom in different periods at two different centres. At Mangalore while the bloom was in November in 1985, at Vizhinjam it was in June of the same year. Blooms of *Skeletonema* sp. was observed once only at Mangalore in February, 1983 and at Madras in June, 1982.

Five other species of phytoplankton which appeared in blooms at the various centres under observation were restricted to any one of the centres during a particular year or years. Thus *Biddulphia* sp. was in blooms at Mangalore in November, 1985, *Thalassionema* sp. and *Thalassiosira subtilis* at Vizhinjam in June, 1985 and 1987 respectively. *Thalassiothrix* sp. was the fourth species in this category which appeared in blooms in Madras in June, 1982.

Trichodesmium sp., the fifth species was reported only from the lower east coast. The period of bloom varied from year to year. Thus in Tuticorin it appeared during August and October in 1985, while in 1986 in August only. In 1987 the bloom occurred in the premonsoon months of April and May. In Madras the two occasions on which *Trichodesmium* were in bloom were June, 1982 and April, 1984.

An evaluation of the environmental features during the period of blooms at the respective centres revealed the following. At Karwar, the *Noctiluca* blooms appeared when there was a drastic reduction in salinity values (19.34‰). *Coscinodiscus* sp. and *Chaetoceros* sp. were in blooms in salinities ranging from 32.40 to 34.43‰. When the blooms occurred the surface temperature was relatively low and between 25.6 and 27.5°C. The dissolved oxygen content was well above optimum level and ranged between 3.79 and 4.25 ml/l.

When the blooms occurred at Mangalore, the temperature was rather high and ranged between 27.5 and 33.5°C. The salinity was also relatively high and varied from 33.97 to 35.3 ‰. The dissolved oxygen values were considerably low in November, 1985 (2.80 ml/l), when *Coscinodiscus* sp., *Rhizosolenia* and *Biddulphia* were in blooms and February (2.53 ml/l) and March, 1986 (2.76 ml/l) when *Coscinodiscus* sp. was in blooms.

At Cochin when *Noctiluca* bloom occurred, the surface temperature varied between 27.0 and 31.5°C. The salinity was also relatively high with a minimum of 32.25 and a maximum of 35.75‰. However, *Fragilaria oceanica* appeared in blooms in low temperature and salinity. The lowest temperature was 22.2°C while the maximum registered was 31.5°C. Most of the temperature values were below 30°C. The salinity values showed a wide range, the lowest being 10.55 and the highest 35.75‰.

Vizhinjam was the centre where single species and mixed species blooms occurred in the different years. When *Noctiluca* blooms occurred at this centre there was no unusual environmental conditions present in the sea. The temperature ranged between 27.80 and 30.00°C, while the salinity varied from 30.6 to 35.68‰. When the mixed bloom of *Fragilaria oceanica, Rhizosolenia* sp, and *Thalassionema* sp. occurred in June, 1985, the temperature was as low as 26°C. However, during another mixed bloom with *Thalassiosira subtilis* as the dominant form in June, 1987 the surface temperature was 24.0°C. During any of the above blooms the salinity registered values between 33.5 and 35.68‰. The dissolved oxygen values always remained well above the optimum level and ranged between 4.50 and 4.85 ml/l.

When the blooms of *Trichodesmium* sp. were noticed from 1985 to 1987, in the Tuticorin waters the surface temperature fluctuated between 28.5 and 31.0°C and salinity between 32.8 and 34.84‰. The oxygen values were fairly high and ranged from 4.62 to 5.15 ml/l. The temperature and salinity values recorded during both the years when this species was in bloom in Madras were almost the same around 28.5°C and 31.0‰ respectively.

An examination of the environmental parameters in relation to blooms for Madras revealed the following. In general, the salinity values were considerably less when blooms occurred. The surface temperature was low (24.38°C) when the bloom of *Noctiluca miliaris* appeared in 1982. However, in 1984 the surface temperature was relatively high (28.4°C) and salinity low (33.6‰). When *Coscinodiscus* sp. was in blooms the surface temperature and salinity showed lower than normal values. *Rhizosolenia* sp., *Skeletonema* sp., and *Thalassiothrix* sp. were also in blooms in low saline cool water.

A close consideration of the foregoing facts indicates that the occurrence of phytoplankton blooms is a regular phenomenon in the coastal waters, than incidental. While it is possible that the interaction of environmental parameters act as triggers for the sudden outbursts of blooms, it is difficult to pin point any one parameter as responsible for this. May be a combination of various parameters is necessary to create an optimum condition for the flowering of any one species. Perhaps it might be a sudden increase or decrease in the values of certain environmental features that act as triggers for an organism to multiply at an explosive rate. Further works, particularly on the effects of blooms on fisheries are under progress.

* * *

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MARINE FISHERIES INFORMATION SERVICE

8/9/89

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6. On the stranding of a Humpback whale in the north Kerala coast
7. On a Burmese fishing raft drifted to Madras
8. On the fishery of *Acetes johni* at Karwar and Tadri

Front cover photo:

A miscellaneous trawl catch landed at Madras Fisheries Harbour.

Back cover photo:

A view of mechanised fishing boats moored at Madras Fisheries Harbour (Kasimode).

MARINE FISH CALENDAR

VII. MADRAS*

S. Ramamurthy, J. C. Gnanamuthu, E. Vivekanandan, P. Ramadoss and S. Chandrasekhar

Madras Research Centre of CMFRI, Madras

Introduction

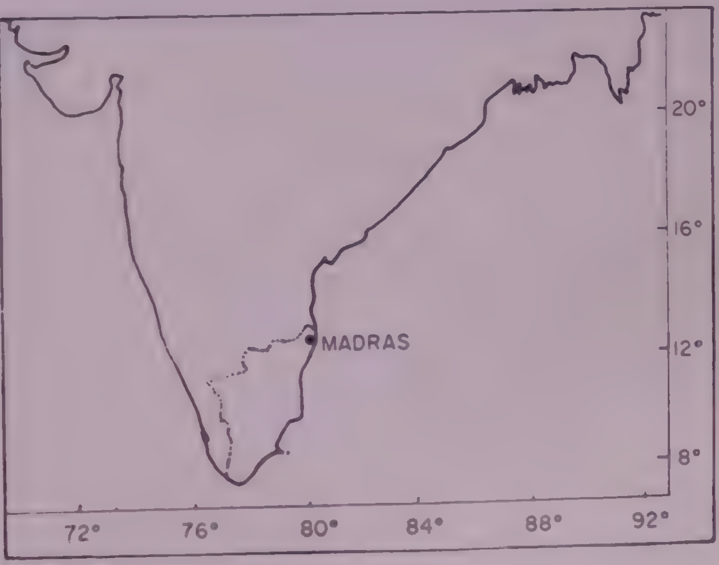
Madras is an important fish landing centre in the east coast. More than 500 trawlers operate from Kasimode centre at Madras, which land about 6,000 tonnes annually. The mechanised gill nets yield about 120 t and the indigenous gears like gill net, bag net and hooks and line bring about 200 t annually. In addition to this, the city has several landing centres from where indigenous gears are operated. For the purpose of preparing the marine fish calendar for Madras, the landing details of the Kasimode centre, which is the only base supporting mechanised boats as well as country crafts were analysed for 1981–'85.

The estimated data on fish groups for which catch details and certain biological information are available are utilized for the preparation of this calendar. The catch details of other miscellaneous groups like cat fish, *Polynemus, Chirocentrus* and crustaceans and cephalopods are not incorporated in this calendar. The monthwise pooled CPUE of trawlers, mechanised gill nets and indigenous gears and the monthwise species composition of fish groups are illustrated.

In the trawl catch, threadfin bream ranks first with an annual catch of 760.5 t forming 12.5%, followed by silver belly, anchovy, croaker and lizard fish. There are no significant variations in the CPUE of threadfin bream throughout the year except during the monsoon period of November and December, when the CPUE is low. In fact, the CPUE of many fishes is low during November and December. Despite cyclonic conditions that prevail during these two months, there is no reduction in the number of fishing operations at Kasimode.

Based on the monthwise analysis of CPUE of trawlers, the different fish groups can be categorised into three: (a) those whose CPUE does not fluctuate very much throughout the year barring the low values during November and December, *e.g.* sole and flat fish, *Thryssa,* seer fish, pomfret, goat fish, silver belly, ray and shark; (b) fishes whose CPUE is comparatively higher in certain months, *e.g.* carangid (September), anchovy (April), grunters (March), skate (November–March), threadfin bream (August and September), sciaenid (November – March) and lizard fish (April – August) and (c) fishes which have a definite peak period of abundance every year, *e.g.* barracuda (September), mackerel (July), drift fishes (August and March), carangids (March), Gerridae (July and August) and ribbon fish (November). They are insignificant at other times of the year.

From Kasimode, about 2,500 mechanised gill net operations are conducted annually in addition to 37,300 operations by non-mechanised gill nets, 1,16,000 operations by bag nets and 37,200 operations by hooks and lines. The landings of mechanised gill nets are constituted mainly by seer fish (44.2%) and shark (16.7%) and those of indigenous gears by lesser sardine (28%) (landed mainly by a specialised gill net known



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* Consolidated by N. Gopinatha Menon and K. Balachandran, CMFRI, Cochin.

locally as 'Kavala valai'), mackerel and *Hilsa* (17.5% each (mainly by bag nets). The CPUE of most of the fishes is very low during November and December as in the case of trawlers. The CPUE of shark (May), tuna (November), seer fish (February and March), sail fish (June and February) and carangid (August and January) from mechanised gill net is higher during the months indicated in parentheses. In the non-mechanised gears, the CPUE of lesser sardine is almost uniform throughout the year and that of shark (September), *Thryssa* (March), mullet (May – July), mackerel (August and March), perch (August) and carangid (August) is higher during the months indicated in parentheses. The CPUE of *Hilsa* is very high during March and meagre during other months.

Fishes such as seer fish, shark and carangid are landed by all the three types of gears, *viz.*, trawl net, mechanised gill net and indigenous gears. An interesting aspect is that the peak period of landing of these groups is different for different gears. For instance, for seer fish the maximum CPUE of mechanised gill net is during March, whereas the CPUE of trawlers and indigenous gears (mainly hooks and line) is very low in this month and high in September and August. This may be due to differences in the fishing area and depth and intensity of operations of these gears during different months of the year.

Monthwise species composition is available for six fish groups. Threadfin bream fishery, which is constituted by five species, is dominated by *Nemipterus japonicus* (53.0%). Silver belly and sciaenid fishery is formed by more than a dozen species each. *Stolephorus bataviensis, Thryssa dussumieri* and *Sardinella gibbosa* constitute the major species of anchovy, dussumier's anchovy and lesser sardine groups respectively. The biological information collected on the six fish groups reveal that they spawn either during December – April or June – September.

CARANGIDAE

Popular English Name : Trevally/Scad
Vernacular Name (Tamil) : 'Parai'
Annual average catch : 247.3 t
Percentage in total catch : —
Fishing methods and their contribution : Trawl net : 37.0%
Gill net : 4.7%
Hooks & line : 13.1%

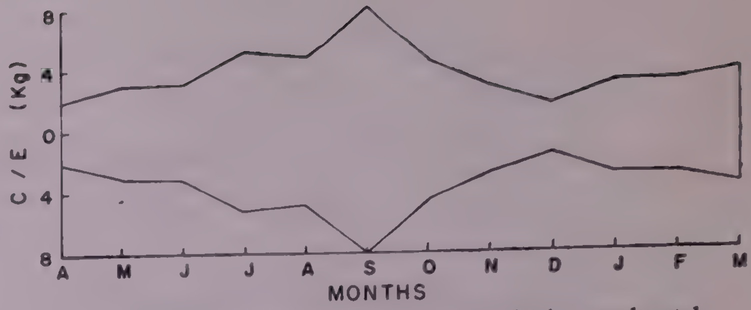

Fig. 1. Seasonal abundance of carangids in trawl catch.

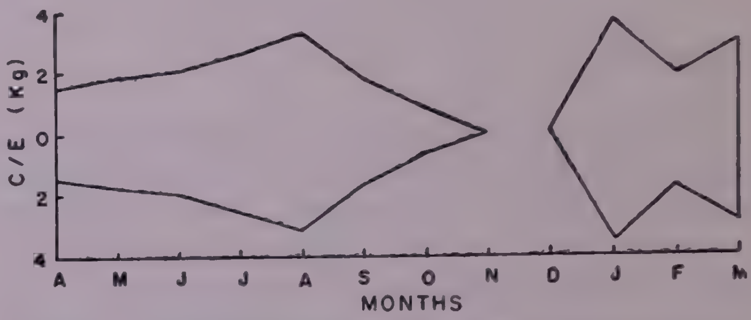

Fig. 2. Seasonal abundance of carangids in gill net catch.

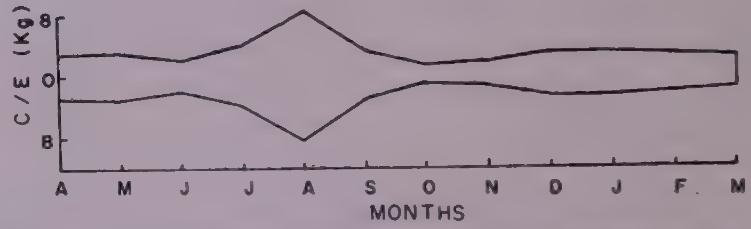

Fig. 3. Seasonal abundance of carangids in indigenous gear catch.

CLUPEIDAE

Popular English Name : Sardine/Lesser sardines
Vernacular Name (Tamil) : 'Kavalai'/'Choodai'/'Sudai'
Annual average catch : 73.5 t
Percentage in total catch : —
Fishing methods and their contribution : Gill net : 28.0%
Bag net : 8.8%

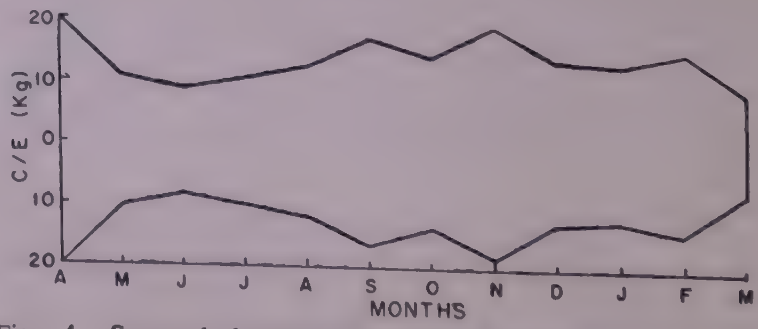

Fig. 4. Seasonal abundance of clupeids in indigenous gear catch.

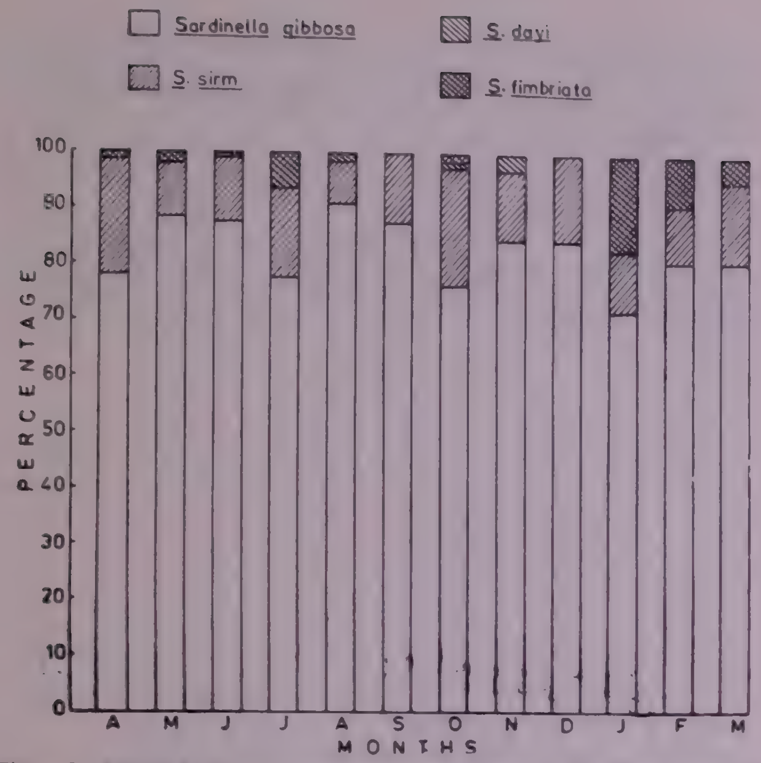

Fig. 5. Monthly species composition of clupeids in gill net catch.

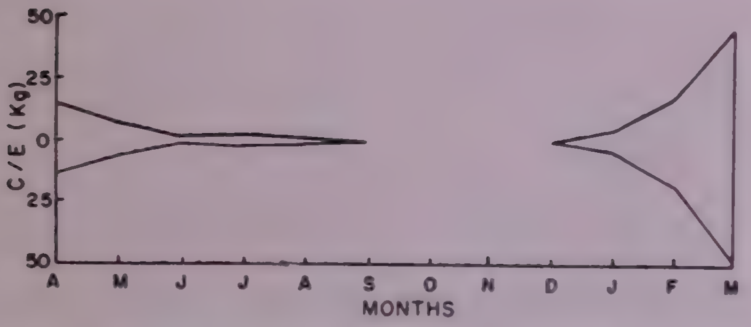

Fig. 6. Seasonal abundance of *Hilsa* in indigenous gear catch.

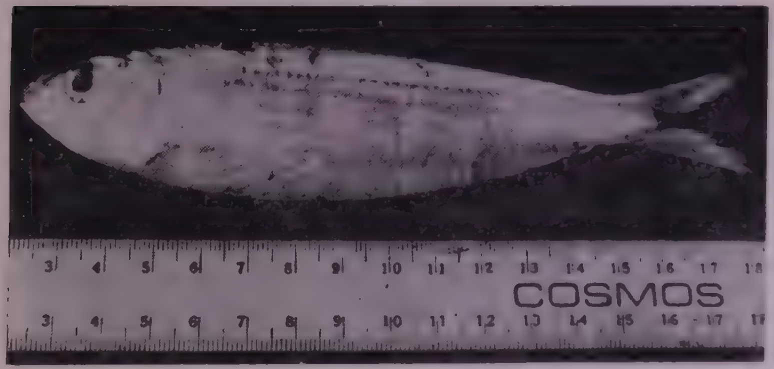

Fig. 7. *Sardinella gibbosa*.

Scientific Name	:	*Sardinella gibbosa*
Vernacular Name	:	'Kavalai'
Gear	:	Trawl net
Percentage in the catch of the group	:	80.9
Peak period of occurrence	:	Oct. to Jan.
Depth of occurrence	:	Upto 20 m
Length range in commercial fishery	:	120 – 130 mm
Size at first maturity	:	—
Spawning season	:	Jan. – Apr.

CYNOGLOSSIDAE, SOLEIDAE, PLEURONECTIDAE AND BOTHIDAE

Popular English Name	:	Flat fishes/Soles/Flounders
Vernacular Name (Tamil)	:	'Aral'/'Nakkumeen'
Annual average catch	:	34.3 t
Percentage in total catch	:	—
Fishing methods and their contribution	:	Trawl net : 0.6%

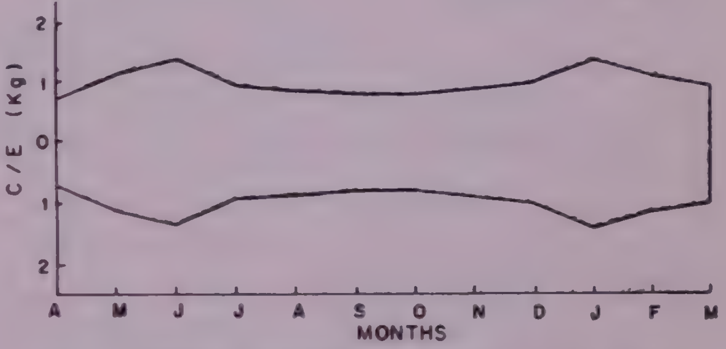

Fig. 8. Seasonal abundance of flat fishes in trawl catch.

ELASMOBRANCHS

Popular English Name	:	Sharks/Skates/Rays
Vernacular Name (Tamil)	:	'Sura'/'Thirukkai'
Annual average catch	:	167.0 t
Percentage in total catch	:	—
Fishing methods and their contribution	:	Trawl net : 2.2% Gill net : 16.7% Hooks & line : 6.6%

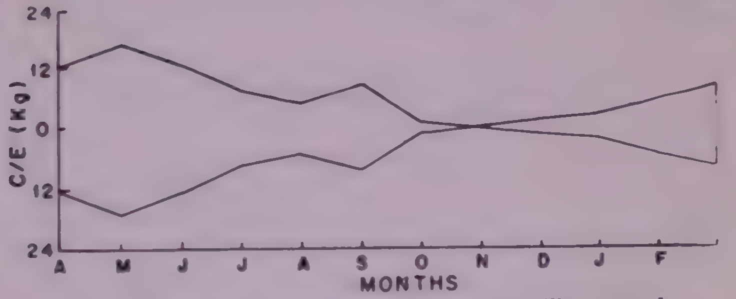

Fig. 9. Seasonal abundance of sharks in gill net catch.

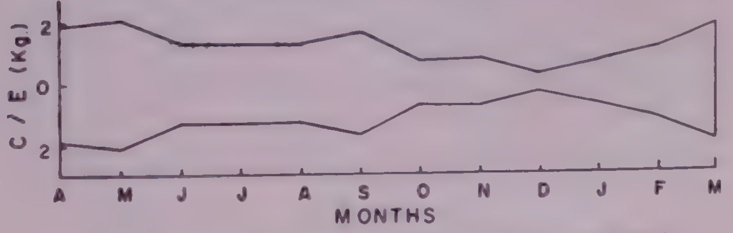

Fig. 10. Seasonal abundance of sharks in trawl catch.

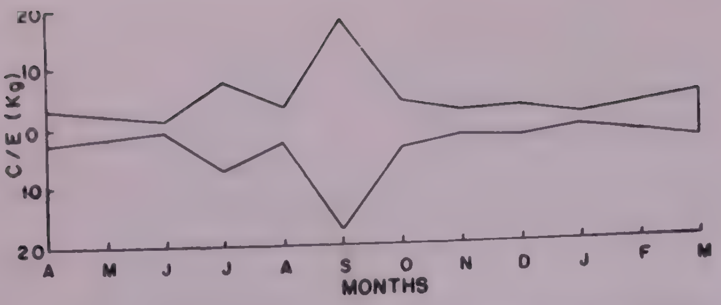

Fig. 11. Seasonal abundance of sharks in indigenous gear catch·

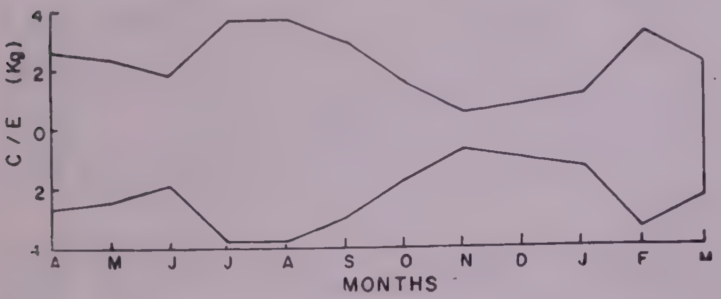

Fig. 12. Seasonal abundance of rays in trawl catch.

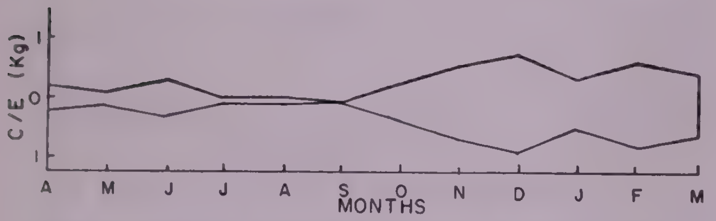

Fig. 13. Seasonal abundance of skates in trawl catch.

ENGRAULIDAE

Popular English Name : Anchovy/Thryssa
Vernacular Name (Tamil) : 'Poruva'/'Nethal'/'Nethili'
Annual average catch : 370.6 t
Percentage in total catch : 7.6
Fishing methods and their contribution : Trawl net : 6.1%
Gill net : 2.6%

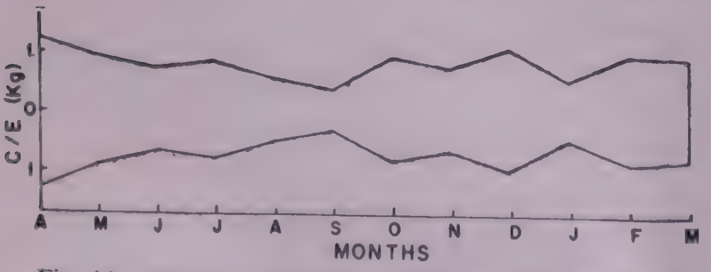

Fig. 14. Seasonal abundance of *Thryssa* in trawl catch.

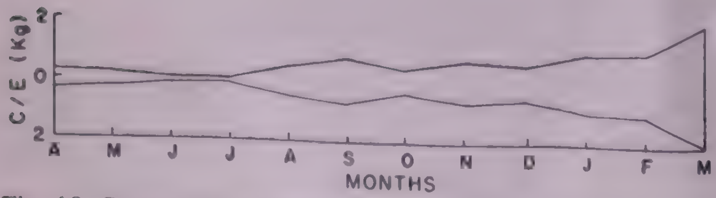

Fig. 15. Seasonal abundance of *Thryssa* in indigenous gear catch.

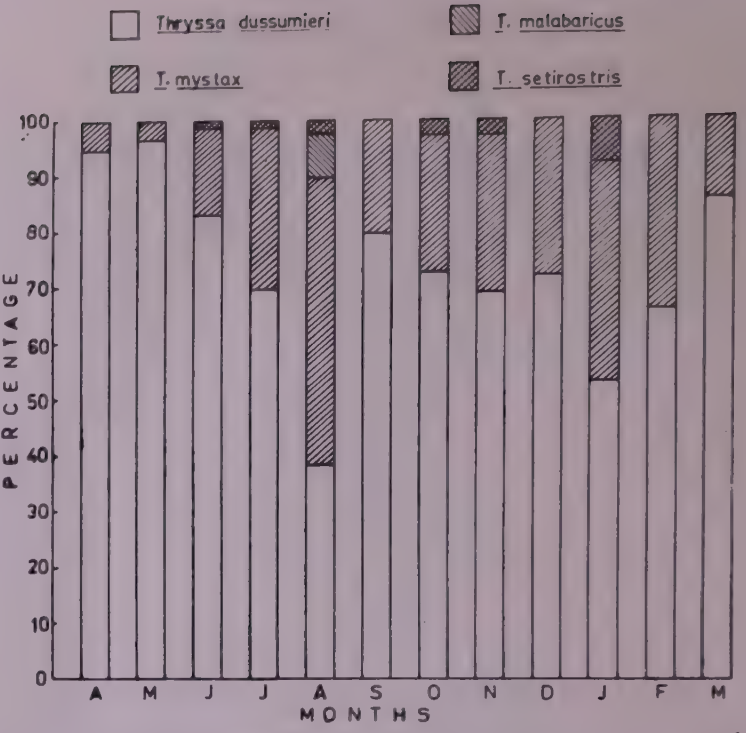

Fig. 16. Monthly species composition of *Thryssa* in trawl catch.

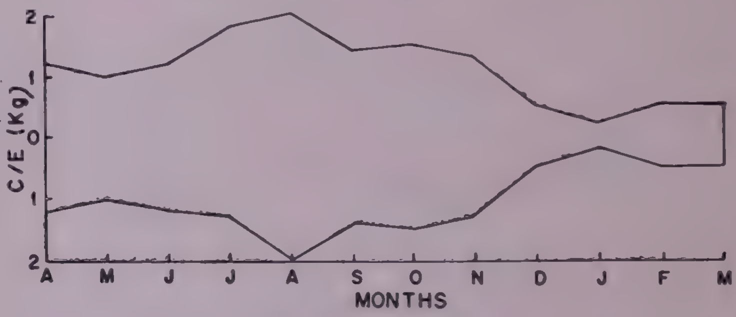

Fig. 17. Seasonal abundance of anchovy in trawl catch.

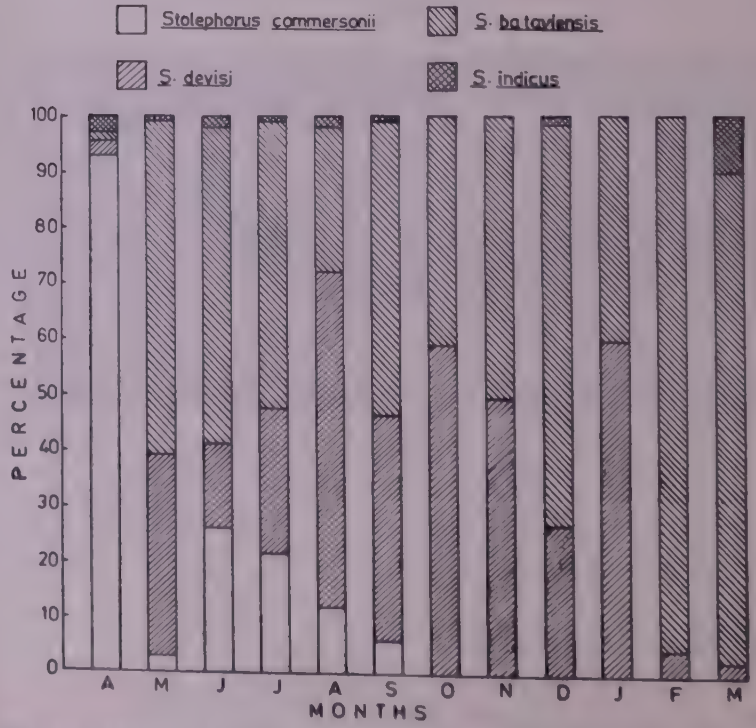

Fig. 18. Monthly species composition of anchovies in trawl catch.

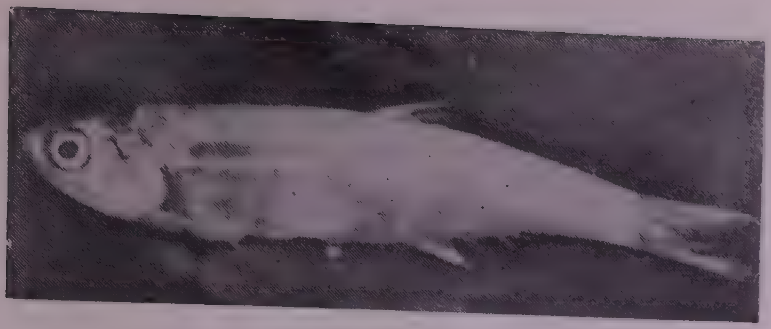

Fig. 19. *Stolephorus bataviensis.*

Scientific Name : *Stolephorus bataviensis*
Vernacular Name : 'Nethili'
Gear : Trawl net
Percentage in the catch of the group : 44.0
Peak period of occurrence : Jul. and Oct.
Depth of occurrence : Upto 30 m
Length range in commercial fishery : 70 – 90 mm
Size at first maturity : —
Spawning season : Jun. – Sep.

GERRIDAE

Popular English Name : Silver biddies
Vernacular Name (Tamil) : 'Oodan'
Annual average catch : 120.2 t
Percentage in total catch : —
Fishing methods and their contribution : Trawl net : 2.0 %

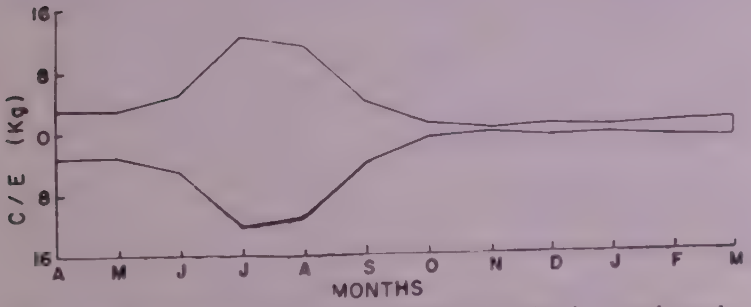

Fig. 20. Seasonal abundance of silver biddies in trawl catch.

ISTIOPHORIDAE

Popular English Name : Sail fish/Bill fish
Vernacular Name (Tamil) : 'Myl meen'
Annual average catch : 6.5 t
Percentage in total catch : —
Fishing methods and their contribution : Gill net : 6.5%

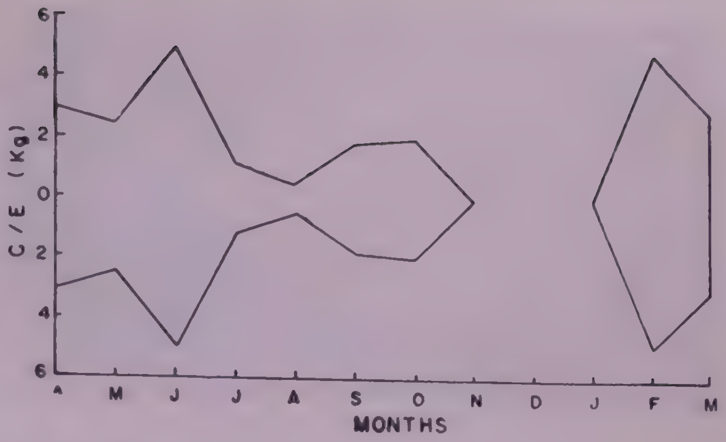

Fig. 21. Seasonal abundance of sail fish in gill net catch.

LEIOGNATHIDAE

Popular English Name : Silver belly
Vernacular Name (Tamil) : 'Karal'
Annual average catch : 600.1 t
Percentage in total catch : 9.9
Fishing methods and their contribution : Trawl net : 10.0%

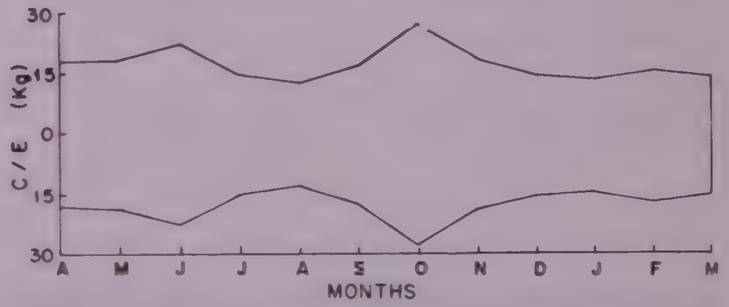

Fig. 22. Seasonal abundance of silver bellies in trawl catch.

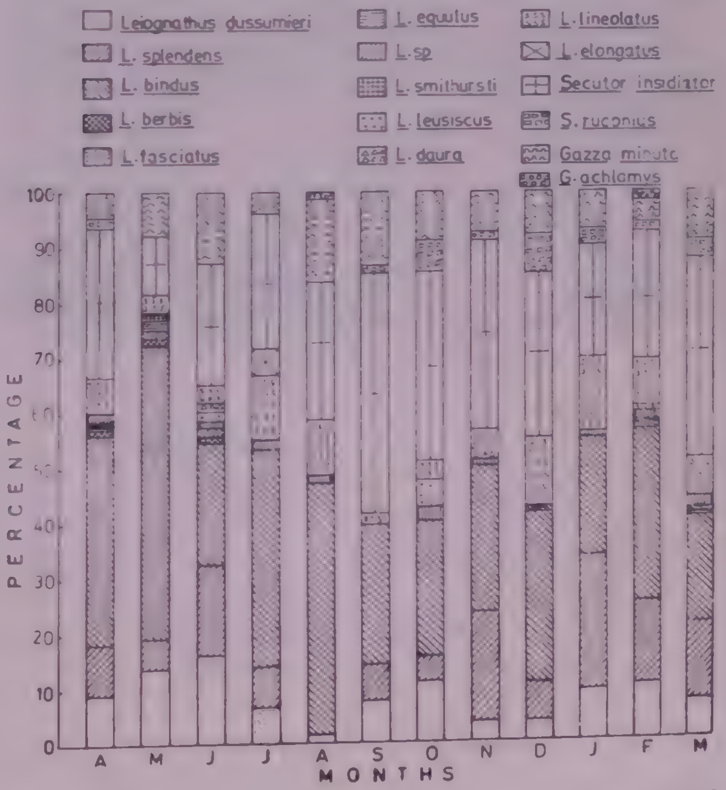

Fig. 23. Monthly species composition of silver bellies in trawl catch.

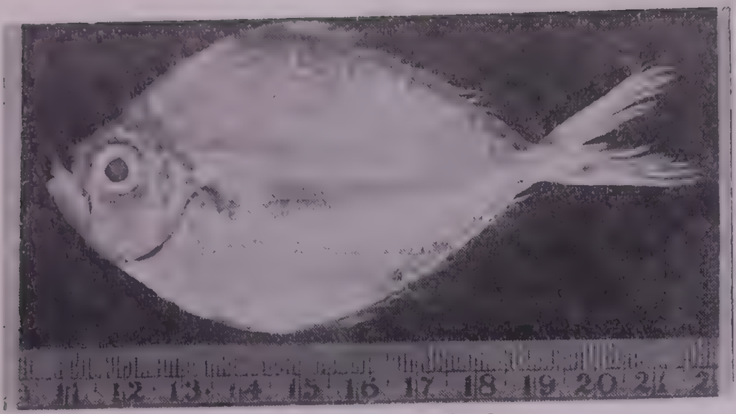

Fig. 24. *Leiognathus bindus.*

Scientific Name	:	*Leiognathus bindus*
Vernacular Name	:	'Karal'
Gear	:	Trawl net
Percentage in the catch of the group	:	30.9
Peak period of occurrence	:	Feb. – May
Depth of occurrence	:	15 – 40 m
Length range in commercial fishery	:	60 – 90 mm
Size at first maturity	:	87 mm
Spawning season	:	Dec. – Apr. and Jun. – Sep.

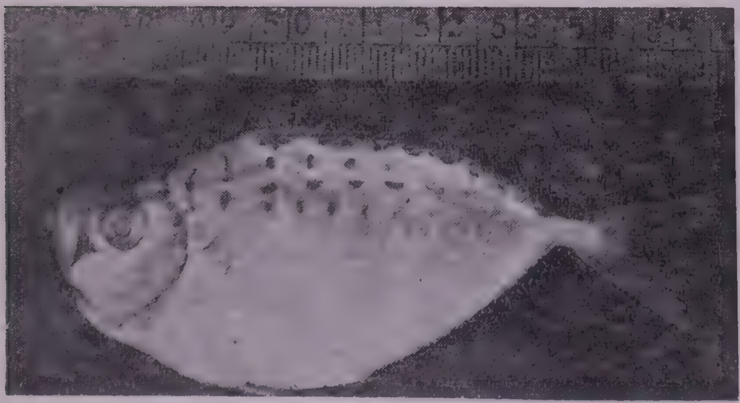

Fig. 25. *Secutor insidiator.*

Scientific Name	:	*Secutor insidiator*
Vernacular Name	:	'Karal'
Gear	:	Trawl net
Percentage in the catch of the group	:	27.8
Peak period of occurrence	:	September
Depth of occurrence	:	15 – 40 m
Length range in commercial fishery	:	60 – 90 mm
Size at first maturity	:	Dec. – Apr. and Jun. – Sep.

MUGILIDAE

Popular English Name	:	Grey mullets
Vernacular Name (Tamil)	:	'Manalai'/'Madavai'
Annual average catch	:	14.6 t
Percentage in total catch	:	—
Fishing methods and their contribution	:	Bag net : 14.6%

MULLIDAE

Popular English Name	:	Goat fish/Red mullet
Vernacular Name	:	'Sennagari'
Annual average catch	:	145.3 t
Percentage in total catch	:	—
Fishing methods and their contribution	:	Trawl net : 2.4%

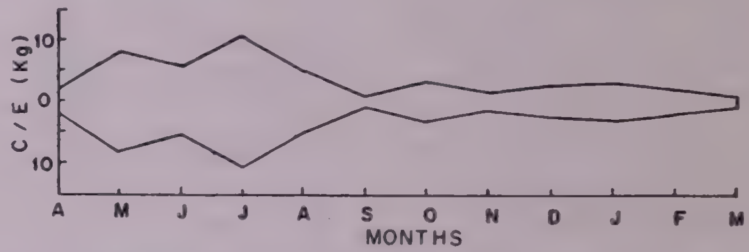

Fig. 26. Seasonal abundance of grey mullets in indigenous gear catch.

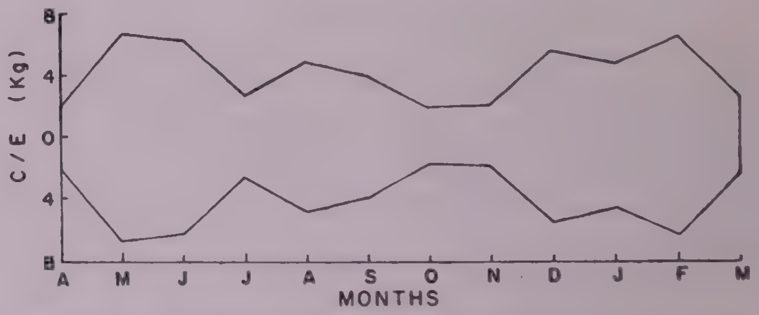

Fig. 27. Seasonal abundance of goat fishes in trawl catch.

NEMIPTERIDAE

Popular English Name	:	Threadfin bream
Vernacular Name (Tamil)	:	'Sankara'
Annual average catch	:	760.5 t
Percentage in total catch	:	12.5
Fishing methods and their contribution	:	Trawl net : 12.7%

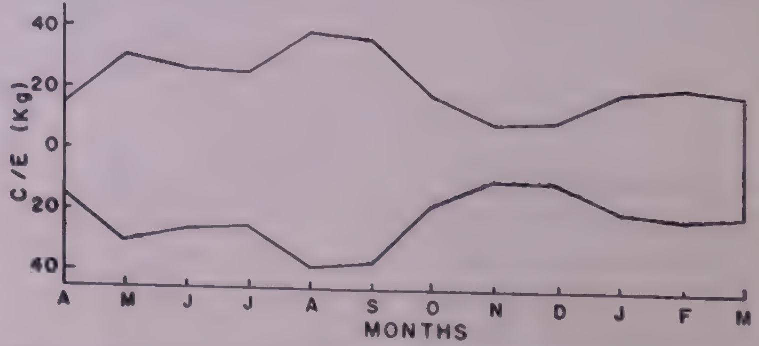

Fig. 28. Seasonal abundance of threadfin breams in trawl catch.

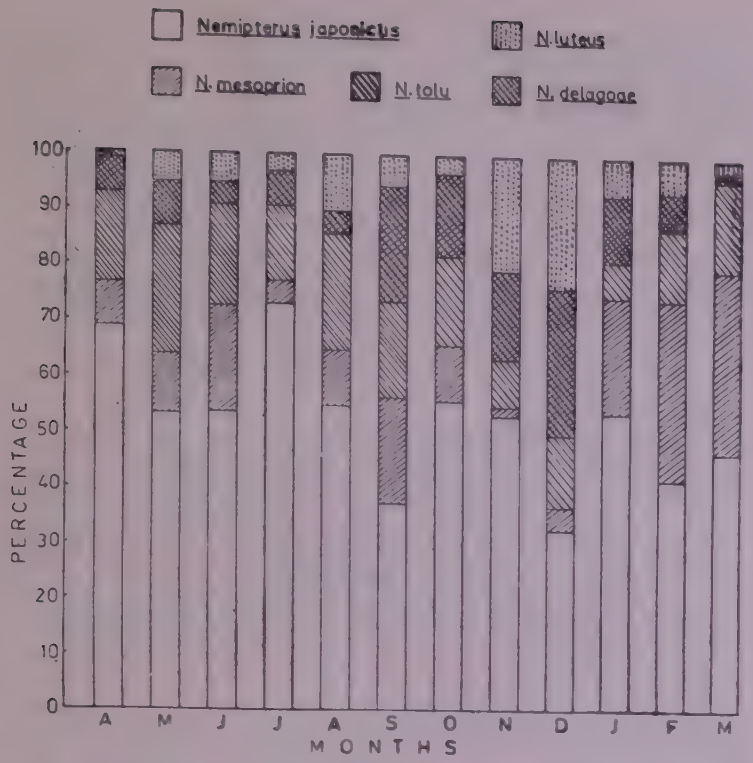

Fig. 29. Monthly species composition of threadfin breams in trawl catch.

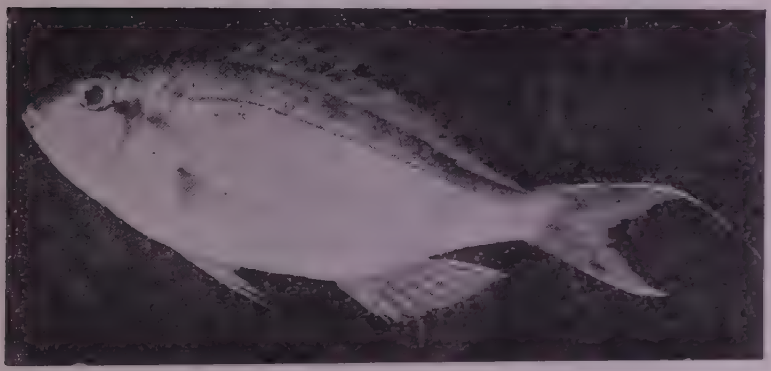

Fig. 30. *Nemipterus japonicus.*

Scientific Name : *Nemipterus japonicus*
Vernacular Name : 'Sankara'
Gear : Trawl net
Percentage in the catch of the group : 53.0
Peak period of occurrence : Jul. – Aug.
Depth of occurrence : 15 – 40 m
Length range in commercial fishery : 130 – 150 mm
Size at first maturity : 145 mm
Spawning season : Dec. – Mar.

NOMEIDAE

Popular English Name : Drift fish/Butter fish
Vernacular Name (Tamil) : —
Annual average catch : 48.4 t
Percentage in total catch : —
Fishing methods and their contribution : Trawl net : 0.8%

POMADASYIDAE

Popular English Name : Grunter
Vernacular Name (Tamil) : 'Kullukorake'/'Kurumatti'/'Curutche'
Annual average catch : 38.9 t
Percentage in total catch : —
Fishing methods and their contribution : Trawl net : 0.6%

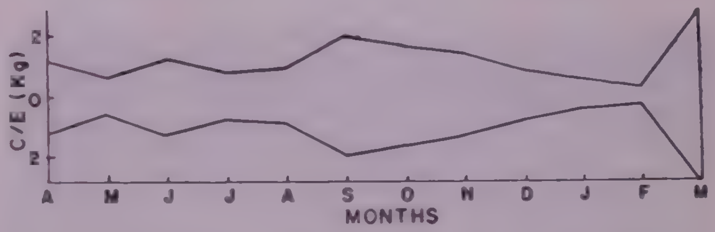

Fig. 31. Seasonal abundance of grunters in trawl catch.

SCIAENIDAE

Popular English Name : Croaker
Vernacular Name (Tamil) : 'Kathalai'
Annual average catch : 346.6 t
Percentage in total catch : 5.7
Fishing methods and their contribution : Trawl net : 5.8%

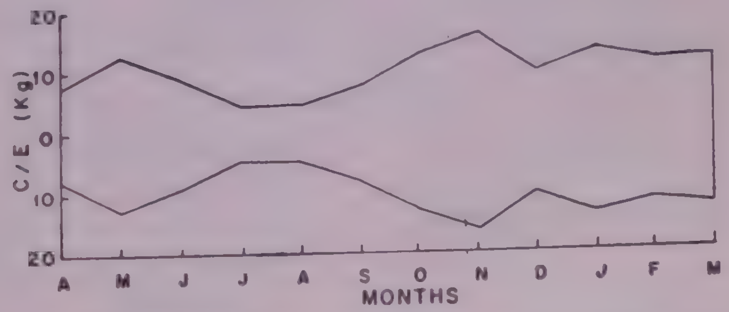

Fig. 32. Seasonal abundance of sciaenids in trawl catch.

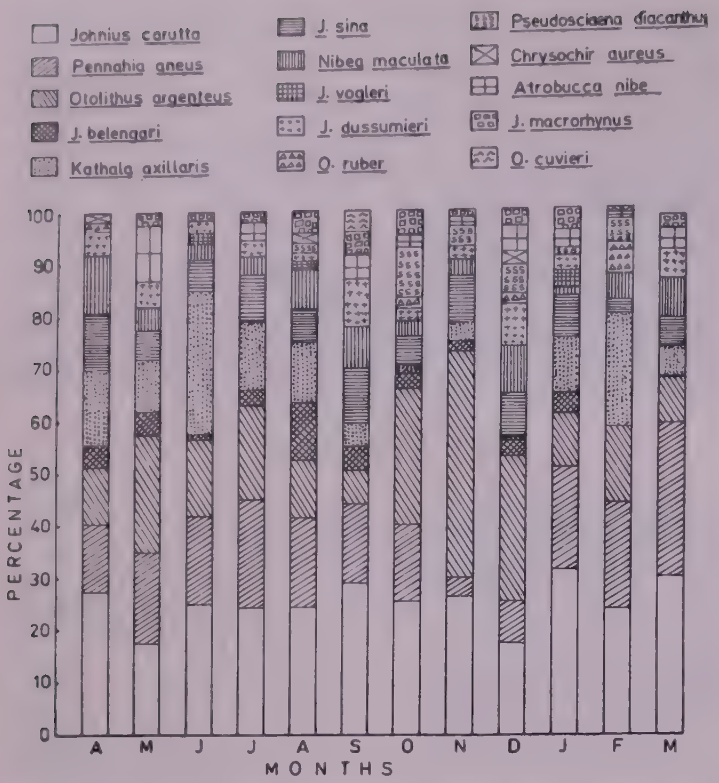

Fig. 33. Monthly species composition of sciaenids in trawl catch.

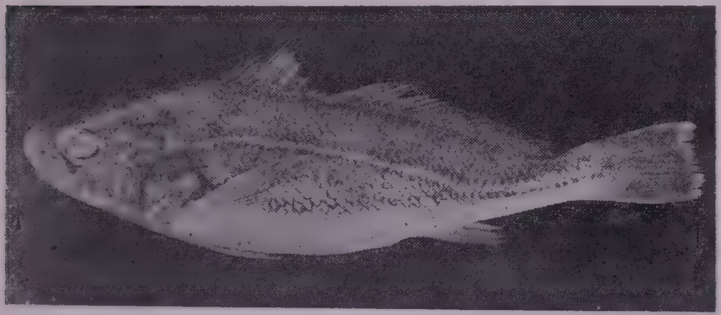

Fig. 34. *Johnius carutta.*

Scientific Name	:	*Johnius carutta*
Vernacular Name	:	'Kathalai'
Gear	:	Trawl net
Percentage in the catch of the group	:	25.5
Peak period of occurrence	:	Jan. – Feb.
Depth of occurrence	:	15 – 40 m
Length range in commercial fishery	:	130 – 150 mm
Size at first maturity	:	140 mm
Spawning season	:	Jun. – Jul.

SCOMBRIDAE

Popular English Name	:	Mackerel/Tunas/ Seer fishes		
Vernacular Name (Tamil)	:	'Kumla'/ 'Kannangeluthi'/ 'Churai'/'Seela Vanjiram'		
Annual average catch	:	111.6 t		
Percentage in total catch	:	—		
Fishing methods and their contribution	:	Trawl net	:	19.4%
		Gill net	:	52.8%
		Hooks & line	:	4.6%
		Bag net	:	17.5%

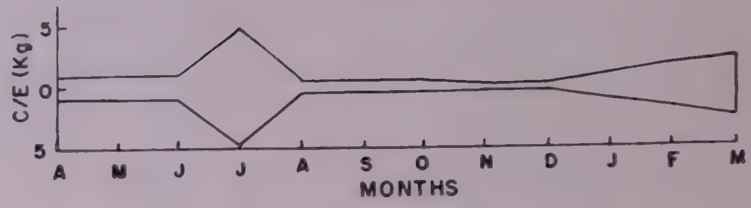

Fig. 35. Seasonal abundance of mackerel in trawl catch.

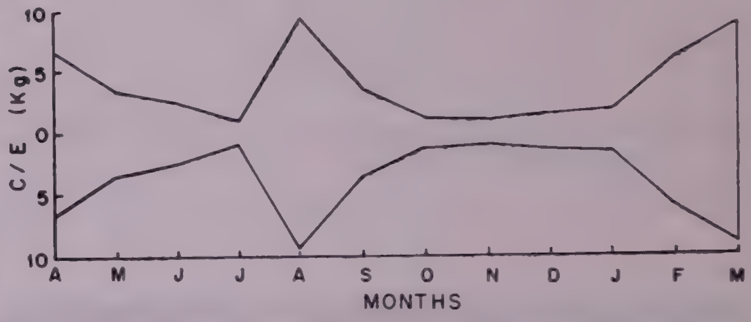

Fig. 36. Seasonal abundance of mackerel in indigenous gear catch.

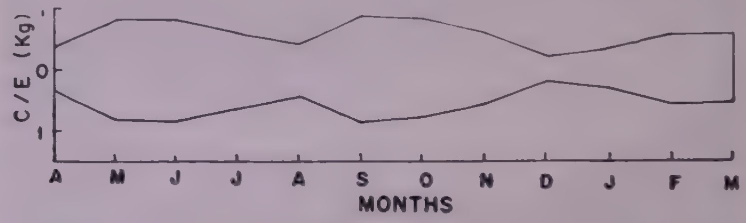

Fig. 37. Seasonal abundance of seer fish in trawl catch.

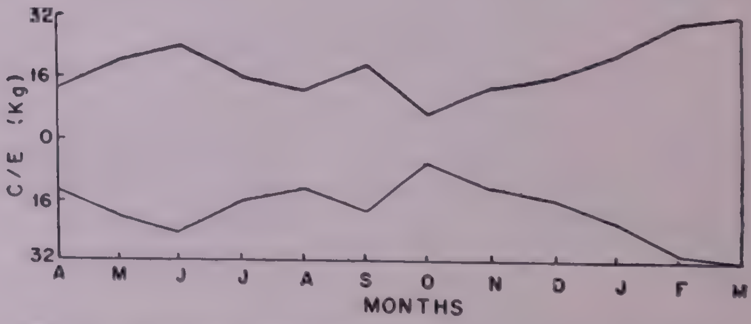

Fig. 38. Seasonal abundance of seer fish in gill net catch.

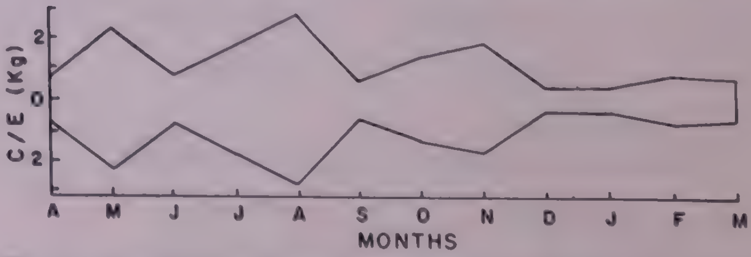

Fig. 39. Seasonal abundance of seer fish in indigenous gear catch.

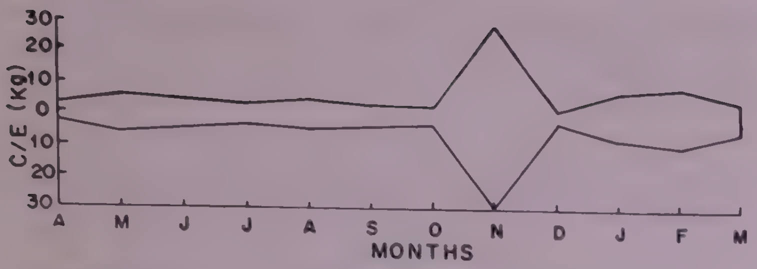

Fig. 40. Seasonal abundance of tuna in gill net catch.

SPHYRAENIDAE

Popular English Name	:	Barracuda
Vernacular Name (Tamil)	:	'Ooli'
Annual average catch	:	43.4 t
Percentage in total catch	:	—
Fishing methods and their contribution	:	Trawl net : 0.7%

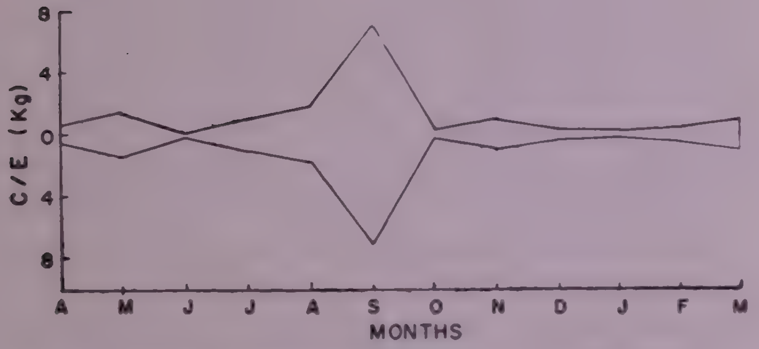

Fig. 41. Seasonal abundance of barracuda in trawl catch.

STROMATEIDAE

Popular English Name	:	Pomfrets
Vernacular Name (Tamil)	:	'Vavval'
Annual average catch	:	19.5 t
Percentage in total catch	:	—
Fishing methods and their contribution	:	Trawl net : 0.3% Gill net : 1.3%

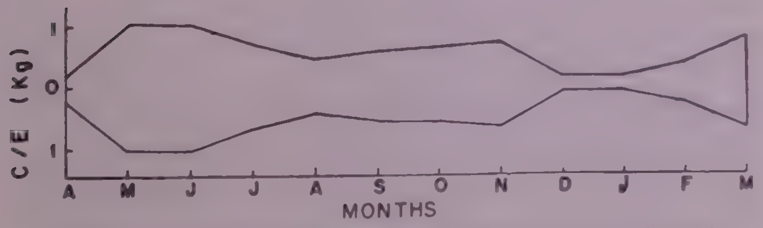

Fig. 42. Seasonal abundance of pomfrets in trawl catch.

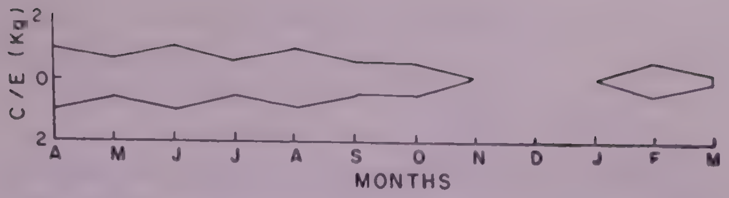

Fig. 43. Seasonal abundance of pomfrets in gill net catch.

SYNODONTIDAE

Popular English Name	:	Lizard fish
Vernacular Name (Tamil)	:	'Oolooway'/ 'Coolooway'
Annual average catch	:	330.6 t
Percentage in total catch	:	—
Fishing methods and their contribution	:	Trawl net : 5.4%

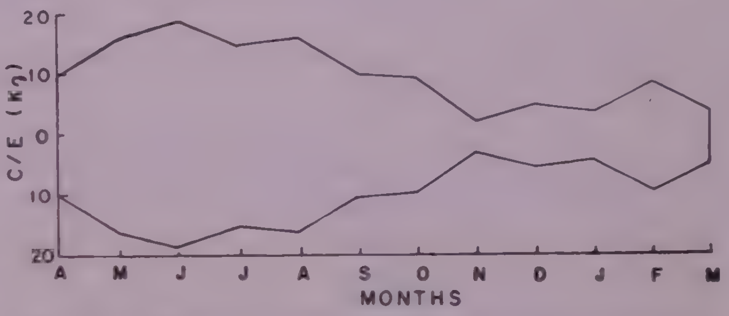

Fig. 44. Seasonal abundance of lizard fish in trawl catch.

TRICHIURIDAE

Popular English Name	:	Ribbon fish
Vernacular Name (Tamil)	:	'Savali'/'Chavalai'/ 'Olavalai'
Annual average catch	:	221.0 t
Percentage in total catch	:	—
Fishing methods and their contribution	:	Trawl net : 2.0%

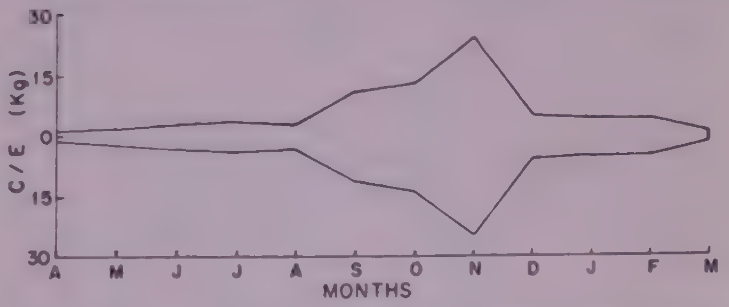

Fig. 45. Seasonal abundance of ribbon fishes in trawl catch.

BUMPER CATCH OF SILVER POMFRET *PAMPUS ARGENTEUS* AT SATPATI BOMBAY*

Heavy catches of silver pomfret *Pampus argenteus* were landed within a span of four days at Satpati, a fishing village in Thane District in Maharashtra (about 100 km north of Bombay). Normally the duration of fishing trip is about 4–5 days depending upon the catch of fish and stock of ice. A crew of 15 operate 5–6 gill net hauls each of 12 hours duration in each trip.

From 7th to 10th September, 1987 the surface gill net boats landed bumper catches of silver pomfret totalling 87 tonnes. The catch details (based on Machimar Society and Sarvodaya Society) are given in Table 1.

Table 1. *Details of silver pomfret catch from 7th to 10th September*, 1987

Date	Catch (kg)	cpue (kg)
7–9–1987	12,709	529.54
8–9–1987	30,166	603.32
9–9–1987	27,460	686.50
10–9–1987	16,681	667.24
Total	87,016	Average 626.01

At the factories of the said societies the pomfrets were graded, based on individual weight. Their percentage and price are given in Table 2.

Table 2. *Details of grade, weight, percentage and price of the silver pomfret*

Grade	Range in wt. (gm)	%	Price/kg (Rs.)
Super	600 and above	47.96	30.00
No. 1	350 – 590	25.93	25.00
No. 2	250 – 340	11.01	21.00
No. 3	200 – 240	2.82	20.00
No. 4	190 and less	3.30	15.00
Cut & soft	—	8.95	—

Silver pomfrets ranged in length from 170 to 320 mm (fork length). It is interesting to note that the catches of pomfrets by the bottom gill nets during this period was very poor.

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* Prepared by V. M. Deshmukh, J. R. Dias and B. B. Chavan, Bombay Research Centre of CMFRI, Bombay.

NURSERY GROUND FOR EARLY JUVENILES OF TIGER PRAWN IN KOVALAM BACKWATER NEAR MADRAS*

The Kovalam backwater (Lat. 12°46' N; Long. 80°18' E) is usually flooded during the northeast monsoon from October–December. Consequently, the sand bar at the mouth of the backwater is cut open to release the accumulated water into the sea and thus avoiding inundation of paddy fields lying adjacent to the backwater. The bar mouth remains open till April – May, during which time, recruitment of larvae and early juveniles of prawns, fishes and crabs takes place continuously, supporting a lucrative fishery in the backwaters during the post and pre-monsoon months, especially for penaeid prawns. For the purpose of utilising the early juveniles of fast growing species of penaeid prawns for field culture, experimental drag net (10 m long; 12 mm mesh size) operations were carried out in the backwater during December 1984. This has brought to light the occurrence of early juveniles of tiger prawn *P. monodon* off Vadanemmeli village.

The total length of juvenile tiger prawn caught ranged between 28 and 91 mm. They were found to be more abundant over the sea grass bed. A maximum of 717 juveniles per 100 m^2 were caught in the drag net operated in the backwaters near Vadanemmeli.

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* Reported by M. Kathirvel and V. Selvaraj, Madras Research Centre of CMFRI, Madras.

The present observations have indicated the rich colonisation of early juveniles of *P. monodon* over the sea grass beds. This congregation could be attributed to the clinging habits of the species in its earlier part of the life. This habit of taking shelter among the grasses may help them to escape from predators. A perusal of literature on the habitat of the species has shown that *P. monodon,* also known as the grass shrimp, takes refuge among the weedy areas in estuaries during its postlarval and early juvenile stages. Taking advantages of the clinging habit of fry of tiger prawn, successful fry collections have been achieved by suspending bunches of twigs and grass from a horizontal rope in the estuaries and bays in Philippines. The abundantly found fry of *P. monodon,* associated with sea grass vegetation in Kovalam backwater can be exploited for meeting the great demand for tiger prawn seeds for farming.

* * *

ON A LARGE ADULT ZEBRA SHARK LANDED AT PAMBAN*

On 7-12-1987, an adult female *Stegostoma faciatum* measuring 207 cm in total length and 49 kg by weight obtained while trawling at 20 m off Pamban in the Gulf of Mannar, was landed at Therkavadi landing centre of Pamban (Fig. 1). Although landing of juveniles of *S. faciatum* are not uncommon along the Indian coasts this is the first record of such a large adult specimen from the southeast coast of India.

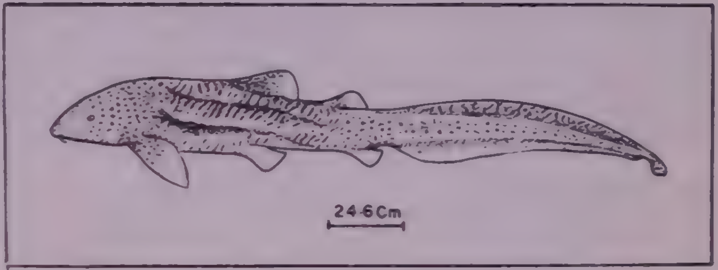

Fig. 1. An oviparous Zebra shark *Stegostoma faciatum* caught off Pamban in Gulf of Mannar.

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* Reported by S. Krishna Pillai and C. Kasinathan, Regional Centre of CMFRI, Mandapam Camp.

* * *

ON A LARGE DEVIL RAY LANDED AT KARWAR*

An unusually large Devil ray (Fig. 1) measuring 386 cm in total length and 447 cm in breadth, caught from the inshore waters off southwest of Karwar at 40 m depth by a mechanised gill net boat, was landed at Karwar on 1-12-1987. It was identified as *Manta birostris,* locally known as 'Kombu torke'. The specimen was a female weighing 800 kg and its liver weighed 40 kg. The fish was disposed off for Rs. 500/- at the landing centre.

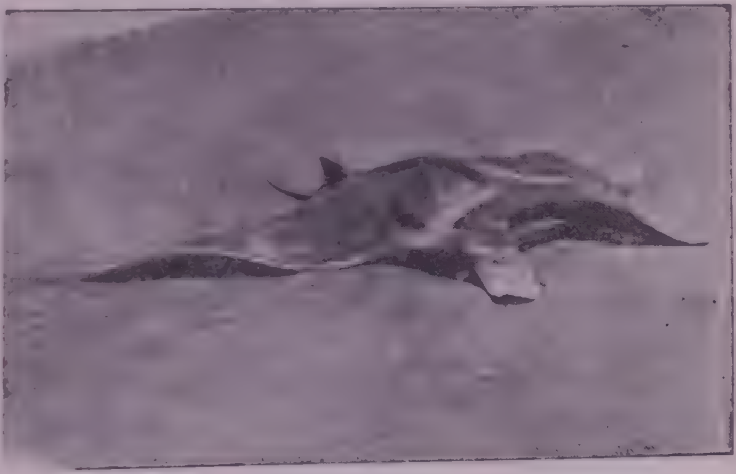

Fig. 1. Devil ray *(Manta birostris)* caught at Karwar.

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* Reported by K. Y. Telang and T. B. Harikantra, Karwar Research Centre of CMFRI, Karwar.

* * *

ON THE STRANDING OF A HUMPBACK WHALE IN THE NORTH KERALA COAST*

On 20–1–1988, a huge dead whale was washed ashore at Mavila Kadappuram (beach) near Nileswaram (Kerala), about 105 km south of Mangalore (Figs. 1 & 2). After two days, it drifted back into the sea by tidal influence and appeared on 24–1–1988 at the barmouth area near Thaikadappuram. The carcass drifted deeper into the backwater by the incoming high tide.

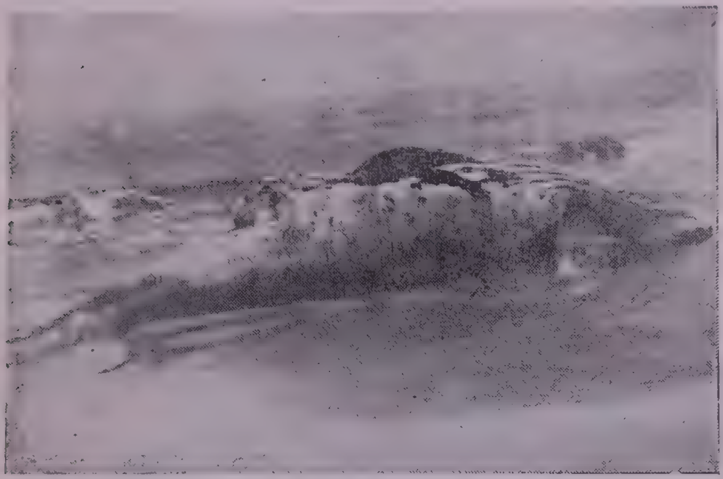

Fig. 1. The stranded female baleen whale *Megaptera novaeangliae* Borowski (Humpback whale) washed ashore on the 20th January, 1988 at Mavila Kadappuram (beach), near Nileshwaram, Kasaragod, Kerala.

The carcass was in a mutilated and highly decomposed state. The whale was approximately 15–16 m in length and weighed about eight tonnes. The flippers were exceptionally larger, measuring 4.6 m in length and the distance between the extremities of caudal fluke was 4.5 m. Detailed measurements could not be made due to the decomposed state. The length of the flipper forming almost 1/3 of the total length confirms the identification of the whale as *Megaptera novaeangliae* Borowski.

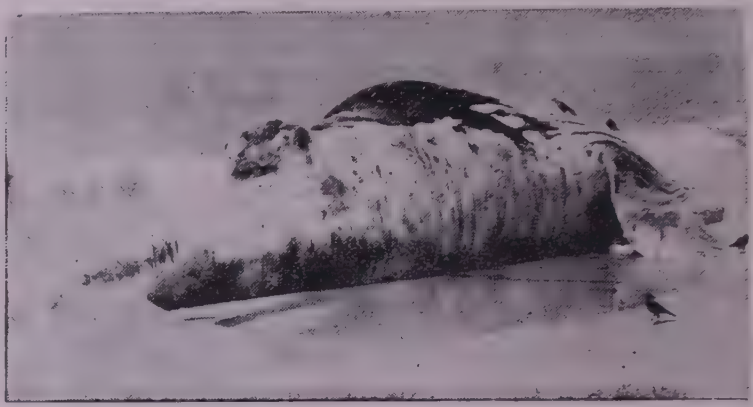

Fig. 2. Ventro-lateral view of the whale stranded at Mavila Kadappuram. Note the extent of throat grooves upto the naval.

It was an adult female. The ventral grooves extending almost near to the naval were mutilated (Fig. 1). The prominent and protruded genital aperture (Figs. 1 & 2) and developed mammary glands indicated that the animal might have released its young one before its death.

It was understood that people from the Kottakal Arya Vaidya Sala near Calicut visited the place on 24–1–1988 and examined the specimen by cutting the viscera presumably to collect the blubber or ambergris for medicinal purpose.

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*Reported by C. Muthiah, Sunil Mohamed, Ganesh Bhatkal and Bharmu Melinmani, Mangalore Research Centre of CMFRI, Mangalore.

ON A BURMESE FISHING RAFT DRIFTED TO MADRAS*

On 6–12–1987, a fishing raft with three crew members was brought to Madras by local fishermen. The raft was from Piyapong Chonkaa, Burma. On 21–11–'87 the raft was anchored in River Iravati. Due to sudden floods in the river, the anchor got lifted and the raft drifted to the sea with three fishermen. The vessel drifted with the current in south-westerly direction for 16 days in the sea and was rescued by the local fishermen near Pulicat on 6–12–1987. There was no net in the raft at the time of rescue.

The raft (length: 12 m; width: 3 m) was fabricated with bamboos in two tiers (Fig. 1). Twentyfive bamboo poles were spread in rows to form the floor and they were tied with ropes. Casuarina poles supported the sides of the raft. The raft had a hut, which was partitioned; one room was for cooking and the other

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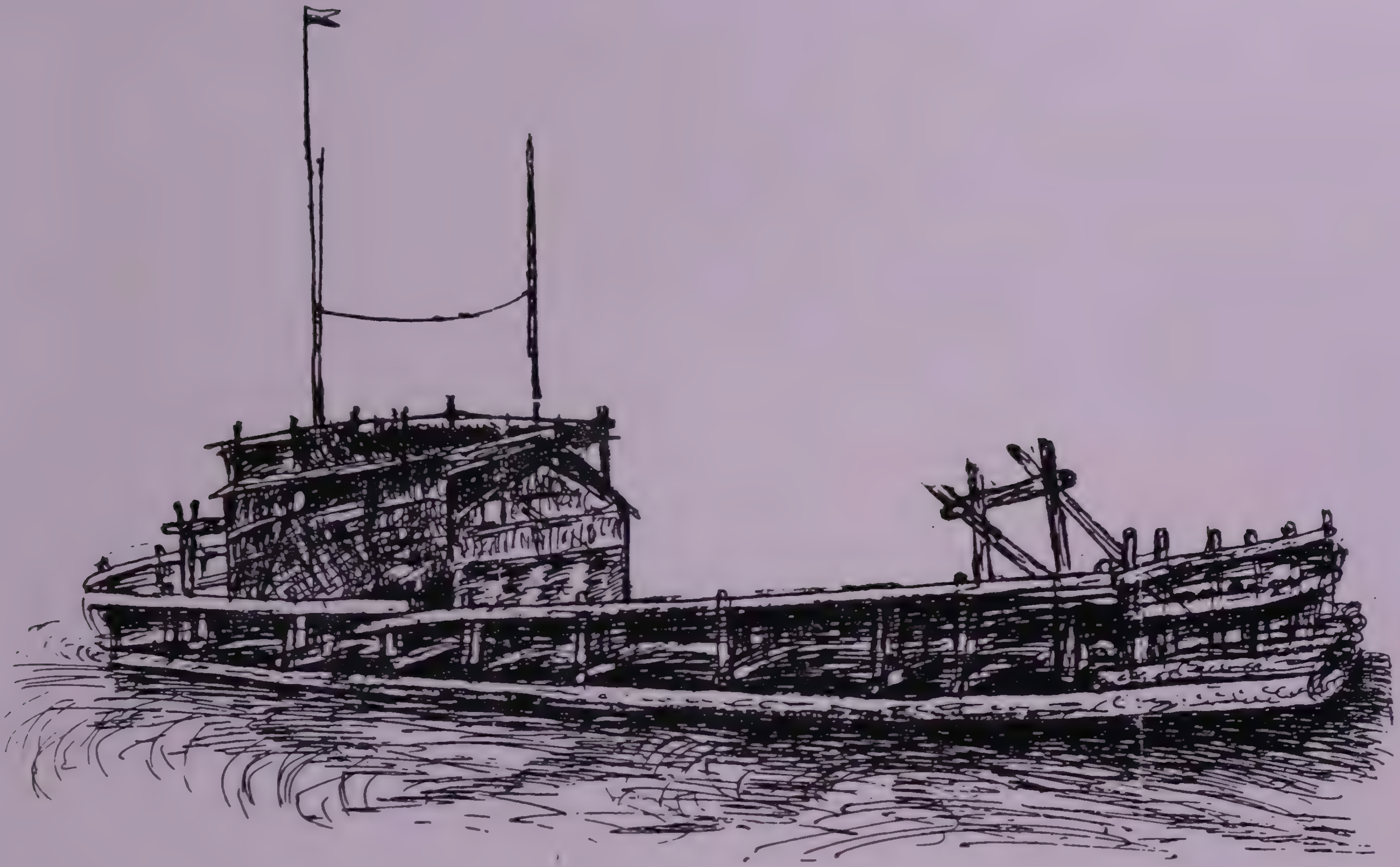
* Reported by S. Srinivasarengan, E. Vivekanandan, K. G. Girijavallabhan, R. Sarvesan, L. Jayasankaran, Madras Research Centre of CMFRI, Madras and K. S. Krishnan, Regional Centre of CMFRI, Mandapam Camp.



for shelter. The approximate value of the raft was Rs. 10,000/-. The raft was later dismantled and sold in Madras and the money was used for the stay of the three fishermen in Madras.

This is not the first time that fishing boats from Burma have drifted towards Tamilnadu Coast. On 10–2–1986, a raft landed in Mudiveeranpatnam (Ramnad District). On 29–3–1987 a similar fishing raft with five fishermen landed in Devanampatnam coast. This vessel was said to have left the Burma coast on 12–2–'87. Later, another fishing raft was rescued near Mandapam on 28–1–1988. It may be noted that all these boats were drifted during November–March, when the current is in south-westerly direction in the Bay of Bengal.

ON THE FISHERY OF *ACETES JOHNI* AT KARWAR AND TADRI*

Acetes shrimps occasionally appear as stray catches along the Karwar coast. During November–December, 1986, *Acetes johni* formed a regular fishery for 40 days both at Karwar and Tadri. The species was found amongst *Oratosquilla nepa, Lepturacanthus savala* and other trash fishes caught by trawlers and purse seiners. The estimated catches of *A. johni* at Tadri and Karwar were 84 and 22 tonnes respectively. There appeared to be a decrease in catch around new moon day and a rise around full moon day. The general sex-ratio was 35:65 for males to females during the season. The size range of the species was 19–22 mm and the water content amounted to 84% of the total wet body weight. From both the centres nearly 106 tonnes (wet weight) of *A. johni* were landed. The estimated sun-dried weight was 16.928 tonnes. The species was sold at Rs. 12 per kg (retail price) on dry weight basis which amounts to a total of Rupees two lakhs during the season.

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* Reported by V. S. Kakati, K. Y. Telang and C. K. Dinesh Karwar Research Centre of CMFRI, Karwar

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8/9/89

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Abbreviation – *Mar. Fish. Infor. Serv., T & E Ser.*, No. **86**: 1988

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1. Marine fish calendar. VIII. Veraval
2. Sponge-generated bioerosion in Lakshadweep
3. Introduction of 43 footer mechanised boats for commercial trawling along the coast of Andhra Pradesh

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Front cover photo:

Polynemus sextarius ('Dara') commonly occurring along the Gujarat coast.

Back cover photo:

A view of fisheries harbour at Veraval.

MARINE FISH CALENDAR

VIII. VERAVAL*

A. P. Lipton, T. Appa Rao, S. G. Raje, C. Gopal, Ranjit Singh, P. B. Thumber and H. K. Dhokia

Veraval Research Centre of CMFRI, Veraval

Introduction

The coastline of Gujarat, spread around 1,660 km is well known for its bombay duck and pomfret fisheries. In this coast, Veraval which is located in the Saurashtra region forms one of the major fish landing centres. The average annual landing is around 50,000 t, forming about 20% of the catch of the Gujarat State.

In the late 50s fishing was confined to the inshore waters of Veraval. The majority of the boats were of sail type and a very few only were mechanised. These boats were using gill nets and long lines. Stern trawling was unknown and the catch of quality fishes like pomfrets, 'ghol' and eels obtained by long liners and gill netters were iced and transported to Bombay by carrier boats and some quantity by train to Ahmedabad, Baroda and Delhi. The majority of miscellaneous varieties were salted and sun dried. There was poor demand for fish among the local populace.

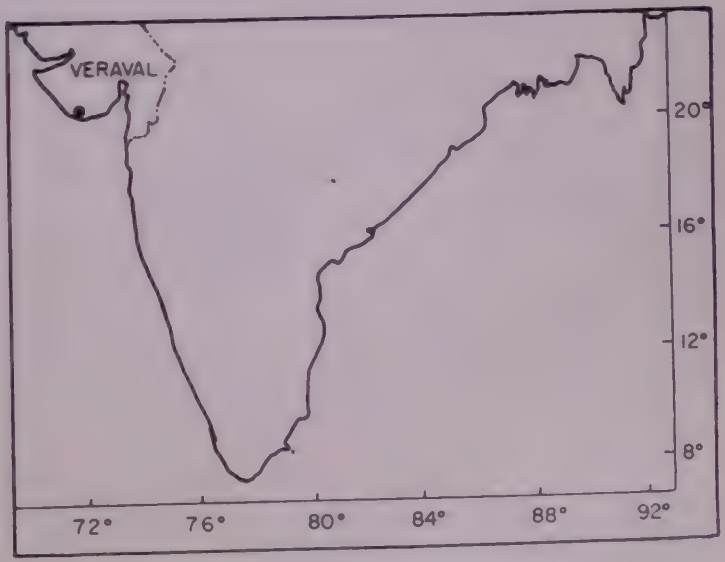
However, after the state was formed in 1960, fisheries developmental activities took a major turn. A new fisheries harbour was planned for Veraval and the fishing pattern underwent a major change with the introduction of stern trawling. At present there are about 800 trawlers, 300 OBM fitted boats and about 50 non-mechanised crafts. The trawlers accounted for about 90% catch and the rest by gill nets and OBM boats. The average monthly catch by trawlers is about 4,000 t (10 months fishing) and by gill netters about 374 t (12 months fishing).

The fishing operations are mainly carried out at about 80 m depth from Dwarka (250 km) towards north to Nawabunder (100 km) towards south. These fishing trips are called 'long trips' which last for about four days and the boats are equipped with long term storage facilities for the quality fishes. The peak landing period is from October to January by the trawlers. The fishing by trawlers remains closed annually for monsoon from 15th of May to 15th of September. During this period maintenance works of vessels are taken up.

During the monsoon period, depending on roughness of sea, gill netters operate to catch pomfrets, 'ghol' and 'dara'. During the fag end of the fishing season many fishermen go for shark hunting, and the oil from the liver of these sharks is used for repair works of the vessels.

During November, the fish catch constituted 15.45% of the total landings and the peak period of October to December accounted for 36% of the annual landings from Veraval. The pelagic resources formed majority of the landings in gill net catch (65.13%); whereas 64% of the demersal resources was landed by trawlers.

By and large the landings of demersal resources are comparatively higher (60.4%) than the pelagic



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*Consolidated by N. Gopinatha Menon and K. Balachandran, CMFRI, Cochin.

resources in Veraval area. The sciaenids form 16% of the trawl landings and 3.4% of the gill net landings. The cat fishes constitute 5.8% of the gill net catch and 0.77% of the trawl landings. The threadfin breams form 3.5% of the total catch.

In Veraval it is observed that due to poor handling and storage facilities about 40% of the catch goes as trash fish and is used for manure and fish meal purpose.

CARANGIDAE

Popular English Name : Trevally/Scads
Vernacular Name (Gujarati) : 'Bangdi'/'Khadwo'
Annual average catch : 953.8 t
Percentage in total catch : 2.1
Fishing methods and their contribution : Trawl net/
Gill net: —

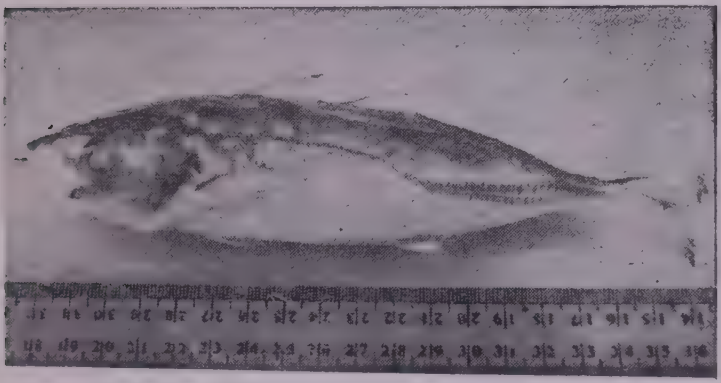

Fig. 1. *Decapterus russelli.*

Scientific Name : *Decapterus russelli*
Vernacular Name : 'Bangdi'
Gear : Trawl net/Gill net
Percentage in the catch of the group : —
Peak period of occurrence : Dec. – Mar.
Depth of occurrence : 20 – 40 m
Length range in commercial fishery : 50 – 150 mm
Size at first maturity : —
Spawning season : —

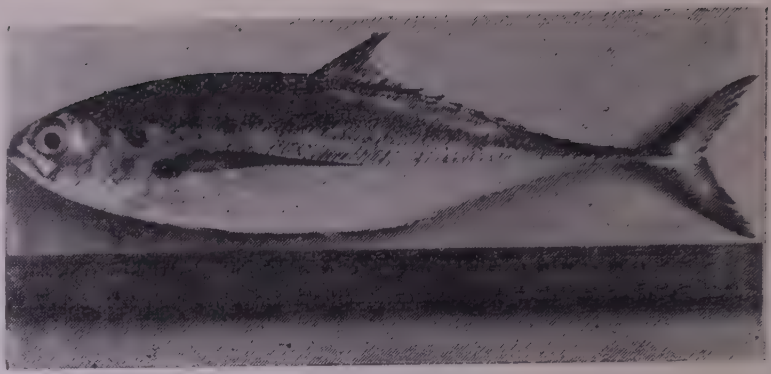

Fig. 2. *Megalaspis cordyla.*

Scientific Name : *Megalaspis cordyla*
Vernacular Name : 'Kati'/'Bangada'
Gear : Trawl net/Gill net
Percentage in the catch of the group : —
Peak period of occurrence : Dec. - Mar.
Depth of occurrence : 20 – 40 m
Length range in commercial fishery : 50 – 150 mm
Size at first maturity : —
Spawning season : —

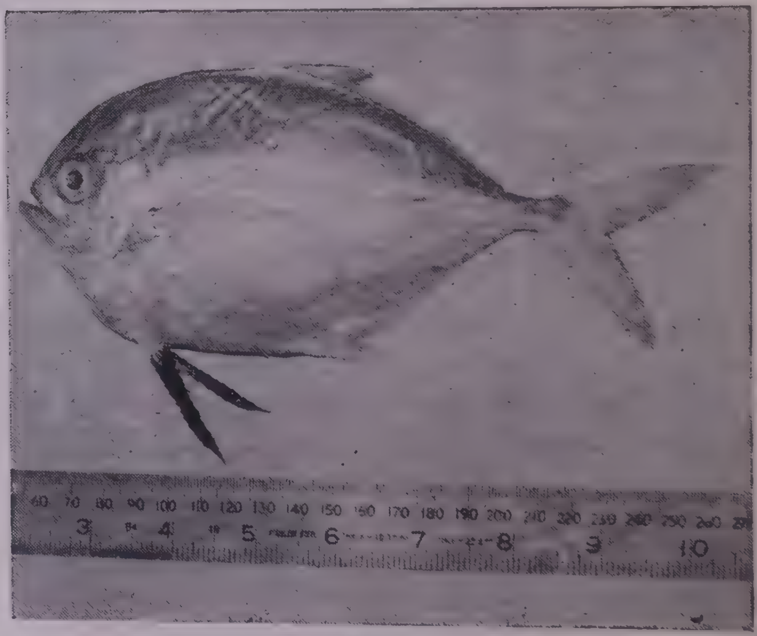

Fig. 3. *Atropus atropus.*

Scientific Name : *Atropus atropus*
Vernacular Name : 'Khadwo'
Gear : Trawl net/Gill net
Percentage in the catch of the group : —
Peak period of occurrence : Nov. – Dec.
Depth of occurrence : 40 – 80 m

Length range in commercial fishery : 100 – 300 mm
Size at first maturity : —
Spawning season : —

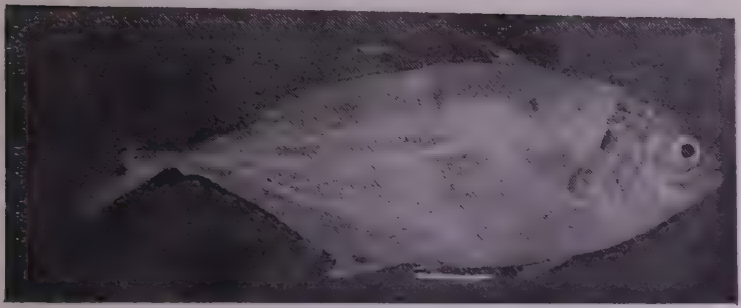

Fig. 4. *Alepes djedaba.*

Scientific Name : *Alepes djedaba*
Vernacular Name : 'Bangdi'
Gear : Trawl net/Gill net
Percentage in the catch of the group : —
Peak period of cccurrence : Sep. – Nov.
Depth of occurrence : 40 – 80 m
Length range in commercial fishery : 150 – 300 mm
Size at first maturity : —
Spawning season : —

CHIROCENTRIDAE

Popular English Name : Wolf herring
Vernacular Name (Gujarati) : 'Dai'
Annual average catch : 723.9 t
Percentage in total catch : 1.6
Fishing methods and their contribution : Gill net: —

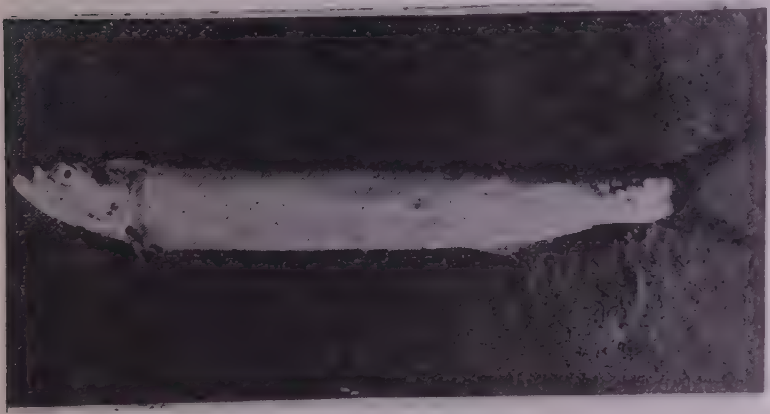

Fig. 5. *Chirocentrus nudus.*

Scientific Name : *Chirocentrus nudus*
Vernacular Name : 'Dai'
Gear : Trawl net/Gill net
Percentage in the catch of the group : 100
Peak period of occurrence : Oct. – Mar.
Depth of occurrence : —
Length range in commercial fishery : 300 – 600 mm
Size at first maturity : —
Spawning season : —

CLUPEIDAE

Popular English Name : Sardines/Shad/Herring
Vernacular Name (Gujarati): 'Chaksi'/'Palva'/'Kati'/'Tarali'
Annual average catch : 623.5 t
Percentage in total catch : 1.4
Fishing methods and their contribution : Gill net/
Trawl net : —

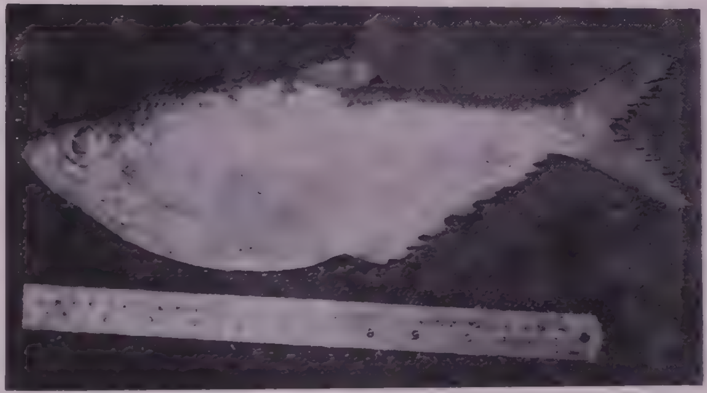

Fig. 6. *Tenualosa toli.*

Scientific Name : *Tenualosa toli*
Vernacular Name : 'Palva'
Gear : Gill net
Percentage in the catch of the group : 92.7
Peak period of occurrence : Oct. – Mar.
Depth of occurrence : 20 – 40 m
Length range in commercial fishery : 150 – 200 mm
Size at first maturity : —
Spawning season : —

CYNOGLOSSIDAE

Popular English Name : Tongue soles
Vernacular Name (Gujarati) : 'Gipti'/'Jeebthi'/'Jeeb'

Annual average catch : 618.7 t
Percentage in total catch : 1.4
Fishing methods and their contribution : Trawl net: —

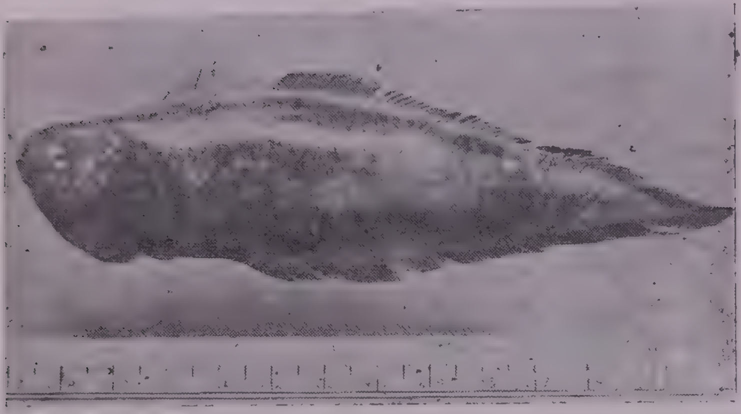

Fig. 7. *Cynoglossus macrostomus.*

Scientific Name : *Cynoglossus macrostomus*
Vernacular Name : 'Gipti'/'Jeebthi'
Gear : Trawl net
Percentage in the catch of the group : —
Peak period of occurrence : Mar. – May
Depth of occurrence : 25 m
Length range in commercial fishery : 100 – 150 mm
Size at first maturity : —
Spawning season : —

ELASMOBRANCHS

Popular English Name : Sharks/Rays/Skates
Vernacular Name (Gujarati) : 'Mogra'/'Lalo'/'Lala'/'Sandho'/'Mushia'/'Patari'/'Kane mushi'/'Tarabla'

Annual average catch : 1,492 t
Percentage in total catch : 3.3
Fishing methods and their contribution : Gill net/Trawl net: —

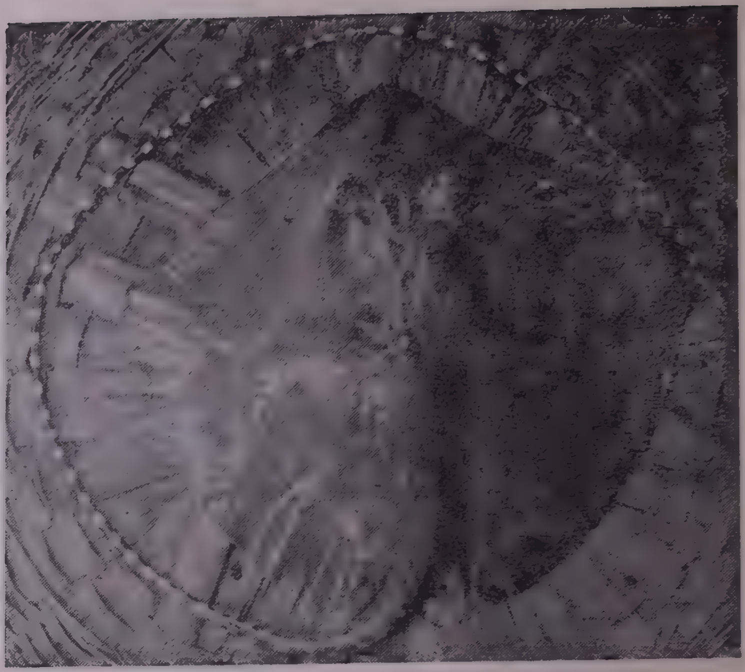

Fig. 8. *Himantura bleekeri.*

Scientific Name : *Himantura bleekeri*
Vernacular Name : 'Tarabla'/'Boor'
Gear : Trawl net
Percentage in the catch of the group : —
Peak period of occurrence : Jan. – Jun.
Depth of occurrence : —
Length range in commercial fishery : 1,000 – 1,400 mm
Size at first maturity : —
Spawning season : —

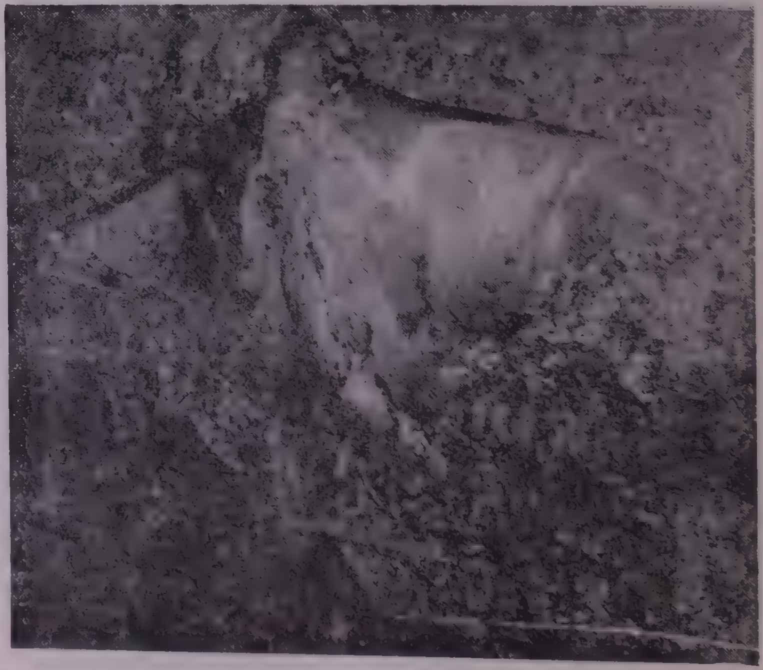

Fig. 9. *Aetobatus narinari.*

Scientific Name : *Aetobatus narinari*
Vernacular Name : 'Wagalin'/'Kodio'
Gear : Trawl net
Percentage in the catch of the group : —
Peak period of occurrence : Apr. – May
Depth of occurrence : —
Length range in commercial fishery : 2,000 – 3,000 mm
Size at first maturity : —
Spawning season : —

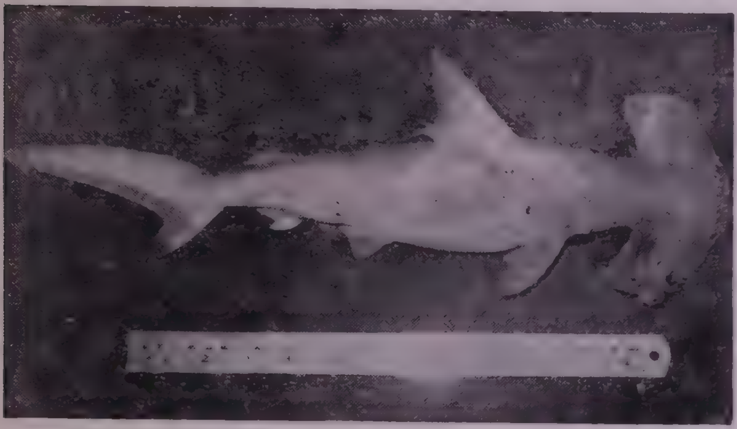

Fig. 10. *Sphyrna mokarran.*

Scientific Name : *Sphyrna mokarran*
Vernacular Name : 'Kane mushi'
Gear : Gill net
Percentage in the catch of the group : —
Peak period of occurrence : Apr. – May
Depth of occurrence : 80 m
Length range in commercial fishery : 2,000 – 2,500 mm
Size at first maturity : —
Spawning season : ---

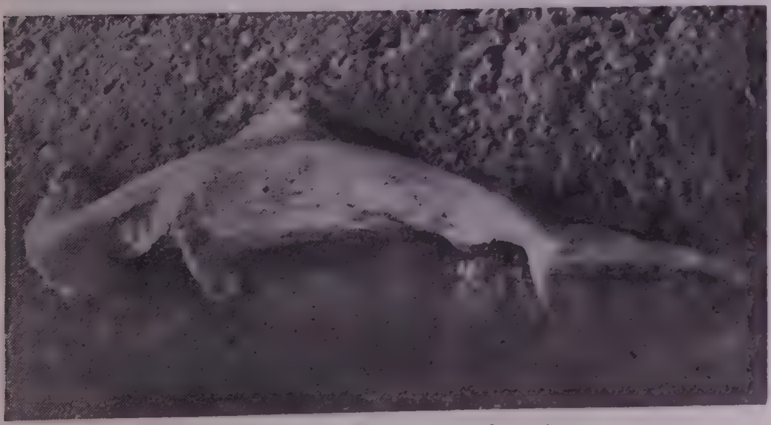

Fig. 11. *Sphyrna lewini.*

Scientific Name : *Sphyrna lewini*
Vernacular Name : 'Kane mushi'
Gear : Gill net
Percentage in the catch of the group : —
Peak period of occurrence : Apr. – May
Depth of occurrence : 80 m
Length range in commercial fishery : 700 – 2,000 mm
Size at first maturity : —
Spawning season : —

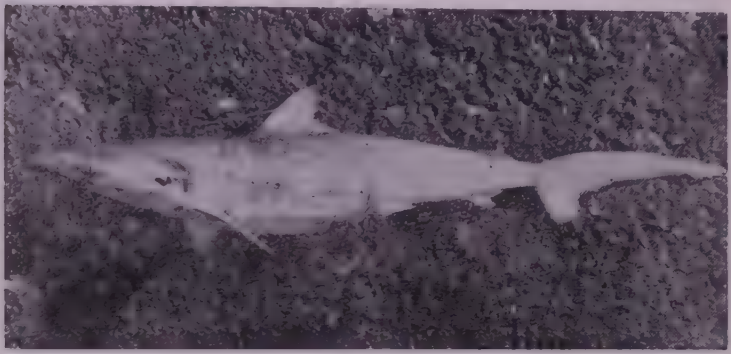

Fig. 12. *Carcharhinus limbatus.*

Scientific Name : *Carcharhinus limbatus*
Vernacular Name : 'Patari'
Gear : Gill net
Percentage in the catch of the group : —
Peak period of occurrence : Oct. – May
Depth of occurrence : 30 – 80 m
Length range in commercial fishery : 500 - 1,500 mm
Size at first maturity : —
Spawning season : —

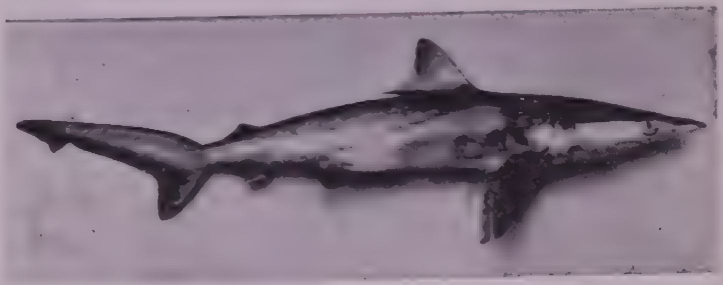

Fig. 13. *Carcharhinus melanopterus.*

Scientific Name : *Carcharhinus melanopterus*
Vernacular Name : 'Patari'
Gear : Gill net
Percentage in the catch of the group : —
Peak period of occurrence : Oct. – May
Depth of occurrence : 30 – 80 m

Length range in commercial fishery : 500 – 1,500 mm
Size at first maturity : —
Spawning season : —

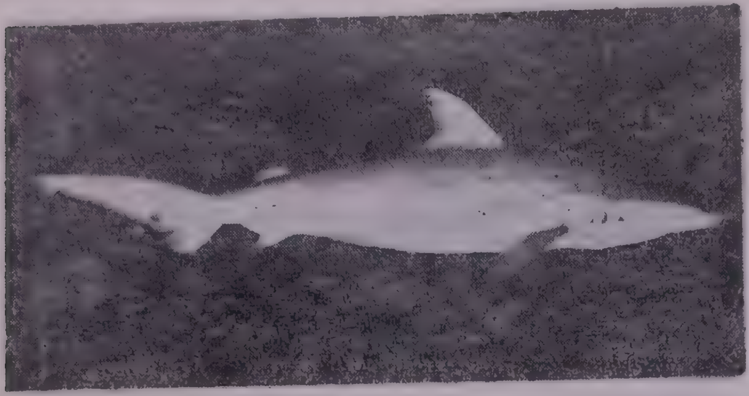

Fig. 14. *Scoliodon laticaudus*

Scientific Name : *Scoliodon laticaudus*
Vernacular Name : 'Sandho'
Gear : Trawl net/Gill net
Percentage in the catch of the group : —
Peak period of occurrence : Oct. – May
Depth of occurrence : 30 – 80 m
Length range in commercial fishery : 300 – 850 mm
Size at first maturity : —
Spawning season : —

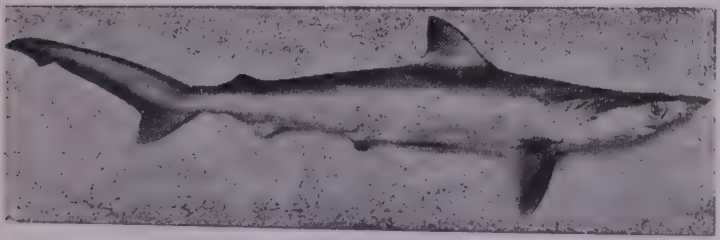

Fig. 15. *Rhizoprionodon acutus.*

Scientific Name : *Rhizoprionodon acutus*
Vernacular Name : 'Sandhi'/'Pisori'
Gear : Gill net/Trawl net
Percentage in the catch of the group : —
Peak period of occurrence : Oct. – May
Depth of occurrence : 30 – 80 m
Length range in commercial fishery : 300 – 750 mm
Size at first maturity : —
Spawning season : —

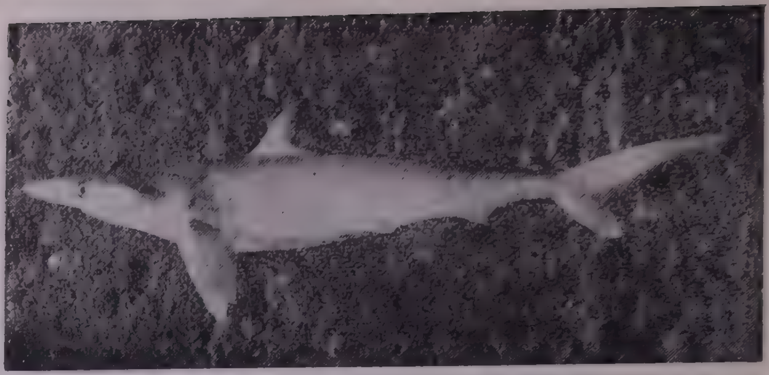

Fig. 16. *Rhizoprionodon oligolinx.*

Scientific Name : *Rhizoprionodon oligolinx*
Vernacular Name : 'Sandhi'
Gear : Gill net/Trawl net
Percentage in the catch of the group : —
Peak period of occurrence : Oct. – May
Depth of occurrence : 30 – 80 m
Length range in commercial fishery : 300 - 750 mm
Size at first maturity : —
Spawning season : —

ENGRAULIDAE

Popular English Name : Anchovies
Vernacular Name (Gujarati) : 'Mandeli'/'Palli'
Annual average catch : 3,592 t
Percentage in total catch : 8.1
Fishing methods and their contribution : Trawl net/
Dol net : —

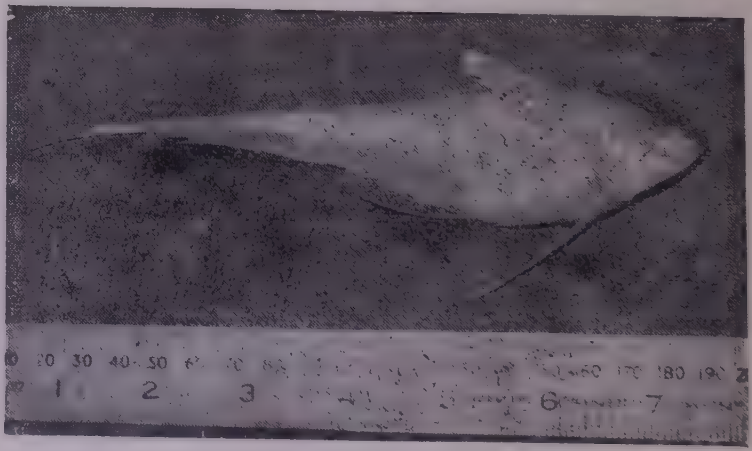

Fig. 17. *Coilia dussumieri.*

Scientific Name : *Coilia dussumieri*
Vernacular Name : 'Mandeli'
Gear : Dol net

Percentage in the catch of the group : 100
Peak period of occurrence : Oct. – Mar.
Depth of occurrence : —
Length range in commercial fishery : 60 – 160 mm
Size at first maturity : —
Spawning season : —

HAEMULIDAE

Popular English Name : Spotted Grunter
Vernacular Name (Gujarati) : 'Kharkara'/'Anther'
Annual average catch : 84.9 t
Percentage in total catch : 0.2
Fishing methods and their contribution : Trawl net: —

HARPADONTIDAE

Popular English Name : Bombay duck
Vernacular Name (Gujarati) : 'Bumla'
Annual average catch : 5.2 t
Percentage in total catch : —
Fishing methods and their contribution : Dol net: —

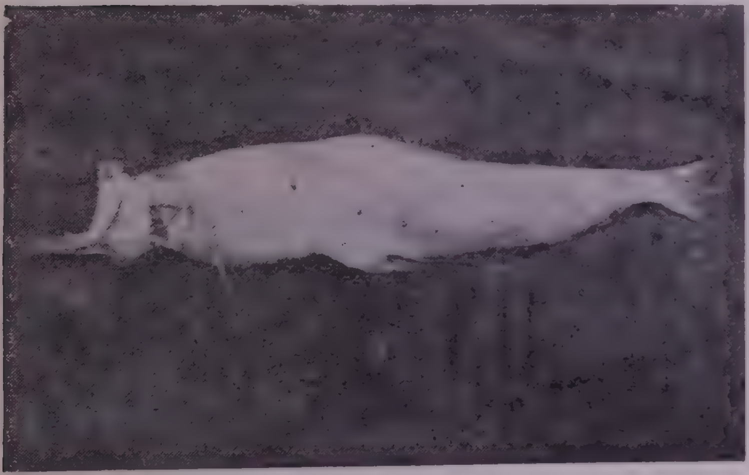

Fig. 18. *Harpadon nehereus.*

Scientific Name : *Harpadon nehereus*
Vernacular Name : 'Bumla'
Gear : Dol net
Percentage in the catch of the group : —
Peak period of occurrence : Mar., May and Nov.
Depth of occurrence : —

Length range in commercial fishery : 30 – 330 mm
Size at first maturity : —
Spawning season : —

LACTARIIDAE

Popular English Name : White fish
Vernacular Name (Gujarati) : 'Dhangari'/'Katli'
Annual average catch : 2,555.3 t
Percentage in total catch : 5.7
Fishing methods and their contribution : Trawl net: —

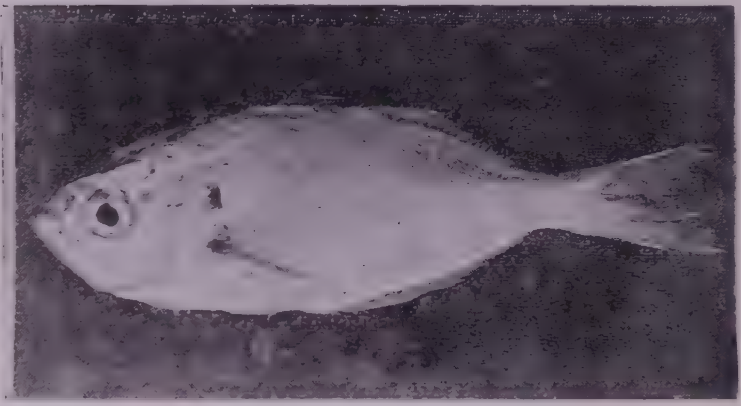

Fig. 19. *Lactarius lactarius.*

Scientific Name : *Lactarius lactarius*
Vernacular Name : 'Dhangari'/Katli'
Gear : Trawl net
Percentage in the catch of the group : 100
Peak period of occurrence : Oct. – Jun.
Depth of occurrence : 60 – 80 m
Length range in commercial fishery : 60 – 120 mm
Size at first maturity : —
Spawning season : —

LETHRINIDAE

Popular English Name : Pig face bream
Vernacular Name (Gujarati) : 'Dhamil'/'Chunco'
Annual average catch : 31.8 t
Percentage in total catch : 0.1
Fishing methods and their contribution : Trawl net: —

LEIOGNATHIDAE

Popular English Name : Pony fish/Silver bellies
Vernacular Name (Gujarati) : 'Kitali'

Annual average catch : 16.6 t
Percentage in total catch : 0.1
Fishing methods and their contribution : Trawl net: —

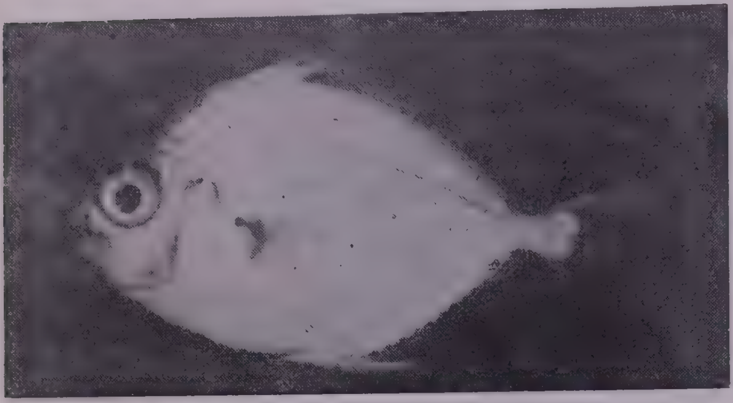

Fig. 20. *Leiognathus splendens.*

Scientific Name : *Leiognathus splendens*
Vernacular Name : 'Kitali'
Gear : Trawl net
Percentage in the catch of the group : —
Peak period of occurrence : Sep. – May
Depth of occurrence : 20 – 80 m
Length range in commercial fishery : 75 – 100 mm
Size at first maturity : —
Spawning season : —

LUTIANIDAE

Popular English Name : Red snapper/Snapper
Vernacular Name (Gujarati) : 'Ratado'
Annual average catch : 95 t
Percentage in total catch : 0.2
Fishing methods and their contribution : Trawl net: —

MULLIDAE

Popular English Name : Goat fishes
Vernacular Name (Gujarati) : 'Chiri'
Annual average catch : 139.6 t
Percentage in total catch : 0.3
Fishing methods and their contribution : Trawl net: —

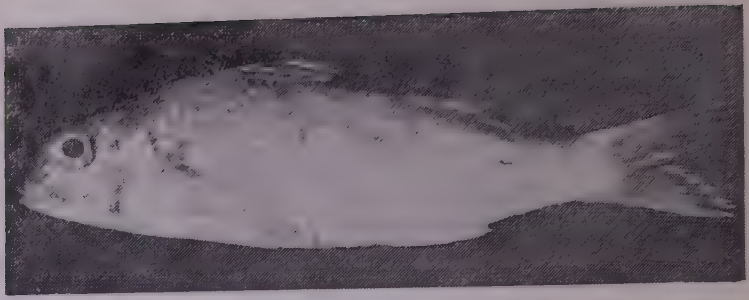

Fig. 21. *Upeneus sulphureus.*

Scientific Name : *Upeneus sulphureus*
Vernacular Name : 'Chiri'
Gear : Trawl net
Percentage in the catch of the group : 100
Peak period of occurrence : Oct. and Dec.
Depth of occurrence : 80 m
Length range in commercial fishery : 100 – 150 mm
Size at first maturity : —
Spawning season : —

MURAENESOCIDAE

Popular English Name : Eel
Vernacular Name (Gujarati) : 'Wam'
Annual average catch : 715.1 t
Percentage in total catch : 1.6
Fishing methods and their contribution : Trawl net: —

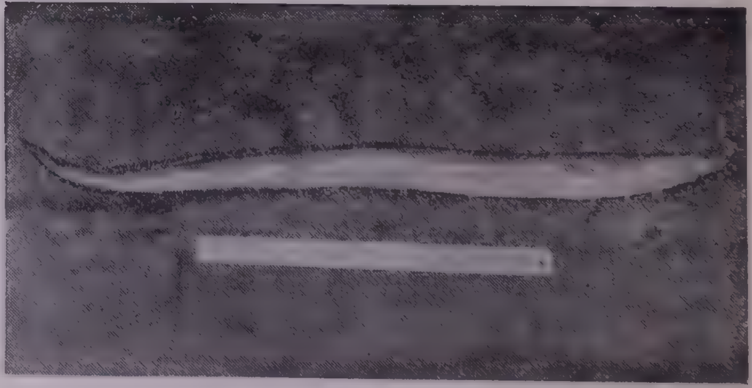

Fig. 22. *Muraenesox talabonoides.*

Scientific Name : *Muraenesox talabonoides*
Vernacular Name : 'Wam'
Gear : Trawl net
Percentage in the catch of the group : —

Peak period of occurrence : Oct. – Jun.
Depth of occurrence : 60 m
Length range in commercial fishery : 500 – 2,500 mm
Size at first maturity : —
Spawning season : —

NEMIPTERIDAE

Popular English Name : Threadfin breams
Vernacular Name (Gujarati) : 'Rathamachla'/ 'Lalmachla'
Annual average catch : 2,232 t
Percentage in total catch : 3.5
Fisbing methods and their contribution : Trawl net: —

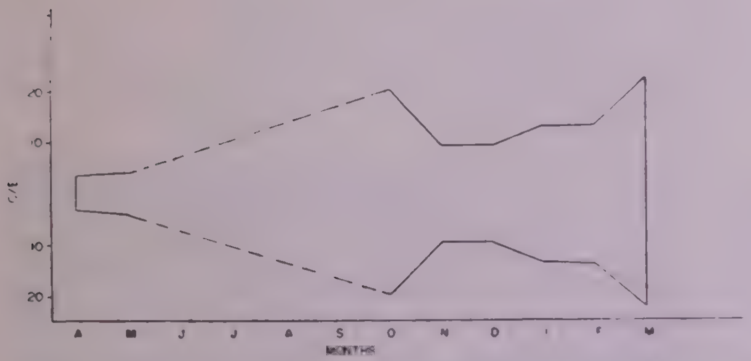

Fig. 23. Seasonal abundance of threadfin breams landed by trawl net.

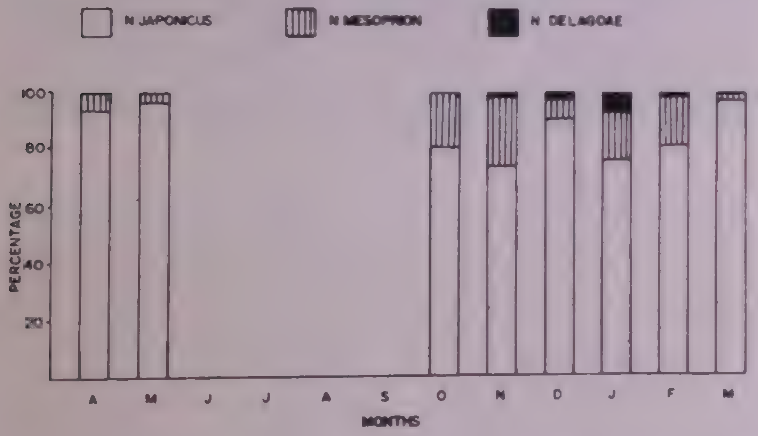

Fig. 24. Monthly species composition of threadfin breams in the trawl catch.

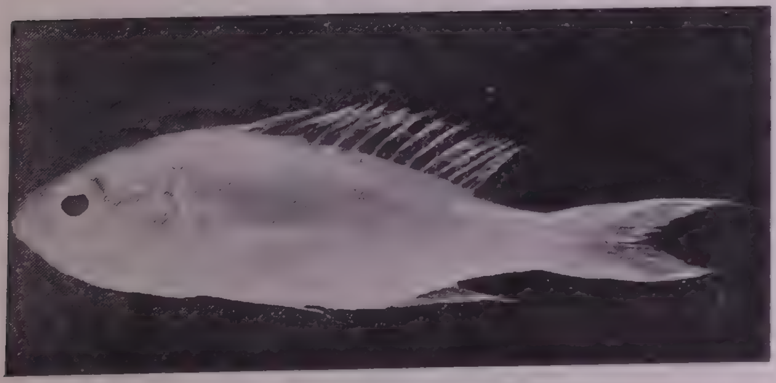

Fig. 25. *Nemipterus mesoprion.*

Scientific Name : *Nemipterus mesoprion*
Vernacular Name : 'Rathamachla'
Gear : Trawl net
Percentage in the catch of the group : 17.2
Peak period of occurrence : Nov. – Dec.
Depth of occurrence : 80 m
Length range in commercial fishery : 120 – 200 mm
Size at first maturity : 135 mm
Spawning season : Oct. and Apr.

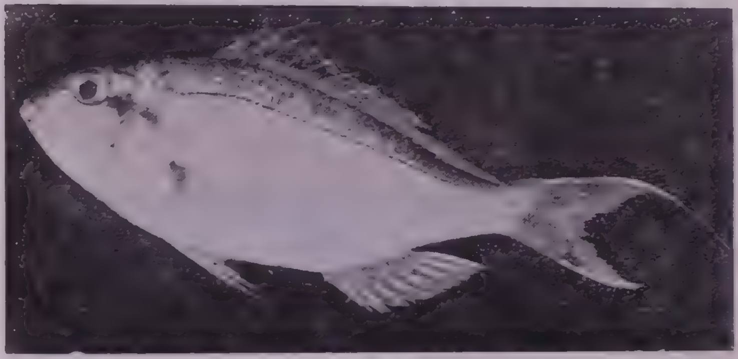

Fig. 26. *Nemipterus japonicus.*

Scientific Name : *Nemipterus japonicus*
Vernacular Name : 'Lalmachla'
Gear : Trawl net
Percentage in the catch of the group : 81.2
Peak period of occurrence : Apr. – Mar.
Depth of occurrence : 80 m
Length range in commercial fishery : 140 – 250 mm
Size at first maturity : 157 mm
Spawning season : Oct. and Apr.

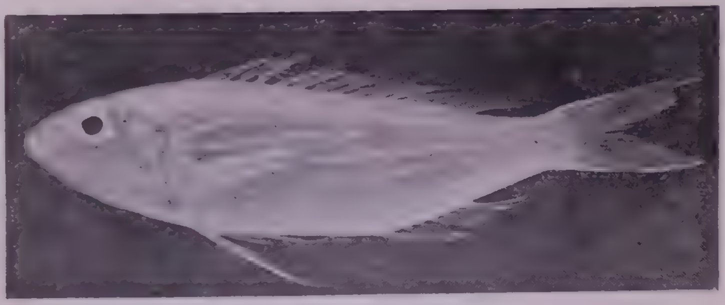

Fig. 27. *Nemipterus delagoae.*

Scientific Name : *Nemipterus delagoae*
Vernacular Name : 'Rathamachla'
Gear : Trawl net
Percentage in the catch of the group : 1.6
Peak period of occurrence : Jan.

Depth of occurrence : 80 m
Length range in commercial fishery : 50 - 500 mm
Size at first maturity : —
Spawning season : —

POLYNEMIDAE

Popular English Name : Indian Salmon/Threadfin
Vernacular Name (Gujarati) : 'Rawas'/'Dara'/'Shin'
Annual average catch : 214.3 t
Percentage in total catch : 0.5
Fishing methods and their contribution : Gill net/Trawl net: —

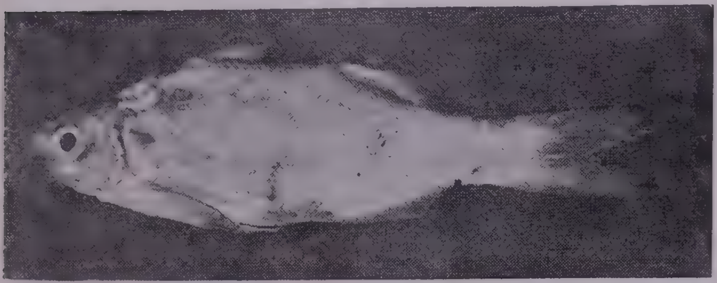

Fig. 28. *Polynemus sextarius.*

Scientific Name : *Polynemus sextarius*
Vernacular Name : 'Dara'
Gear : Trawl net
Percentage in the catch of the group : —
Peak period of occurrence : Jan.
Depth of occurrence : 60 m
Length range in commercial fishery : 150 - 200 mm
Size at first maturity : —
Spawning season : —

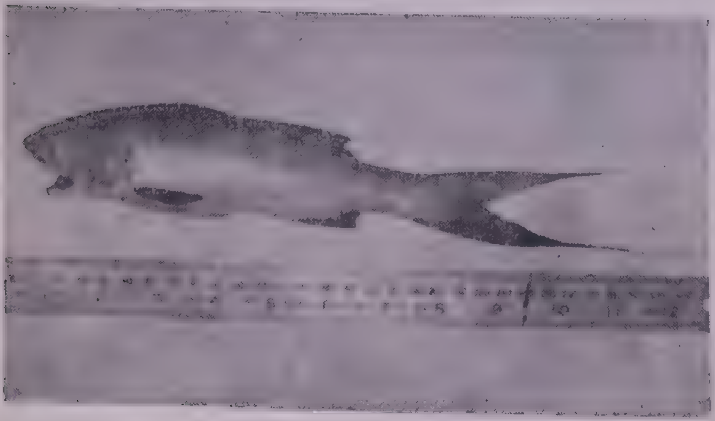

Fig. 29. *Polynemus indicus.*

Scientific Name : *Polynemus indicus*
Vernacular Name : 'Dara'
Gear : Gill net
Percentage in the catch of the group : —
Peak period of occurrence : Jan. - Feb.
Depth of occurrence : 40 m
Length range in commercial fishery : 50 - 100 mm
Size at first maturity : —
Spawning season : —

PRIACANTHIDAE

Popular English Name : Bull's eye
Vernacular Name (Gujarati) : 'Kashi'
Annual average catch : 52.4 t
Percentage in total catch : 0.1
Fishing methods and their contribution : Trawl net: —

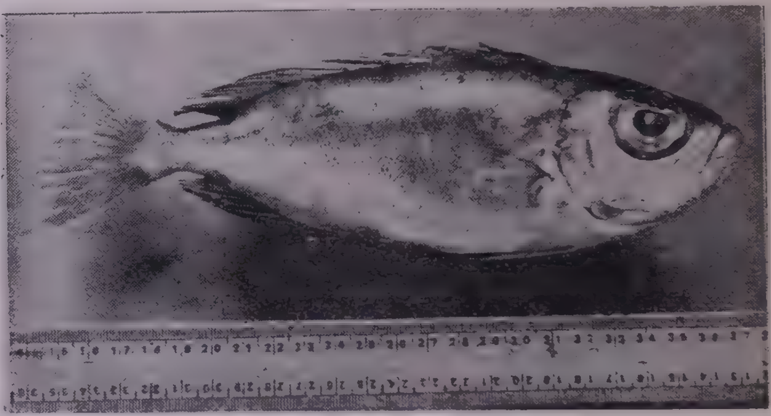

Fig. 30. *Priacanthus hamrur.*

Scientific Name : *Priacanthus hamrur*
Vernacular Name : 'Kashi'
Gear : Trawl net
Percentage in the catch of the group : 100
Peak period of occurrence : Nov. - Dec.
Depth of occurrence : 80 m
Length range in commercial fishery : 200 - 250 mm
Size at first maturity : —
Spawning season : —

PSETTODIDAE

Popular English Name : Indian halibut
Vernacular Name (Gujarati) : 'Hairo'/'Dataro'
Annual average catch : 87 t
Percentage in total catch : 0.2
Fishing methods and their contribution : Trawl net: —

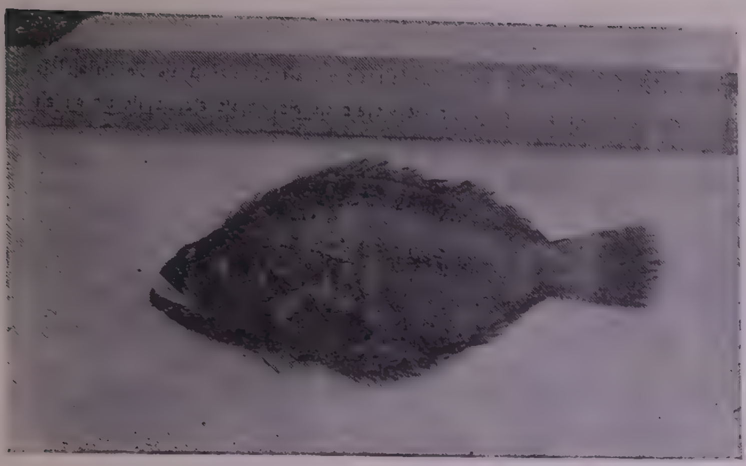

Fig. 31. *Psettodes erumei*.

Scientific Name : *Psettodes erumei*
Vernacular Name : 'Hairo'/'Dataro'
Gear : Trawl net
Percentage in the catch of the group : —
Peak period of occurrence : Oct. – Jan.
Depth of occurrence : 80 m
Length range in commercial fishery : 200 – 400 mm
Size at first maturity : —
Spawning season : —

SCIAENIDAE

Popular English Name : Croakers/Jew fish
Vernacular Name (Gujarati) : 'Dhoma'
Annual average catch : 6,579 t
Percentage in total catch : 14.8
Fishing methods and their contribution : Trawl net
Gill net: —

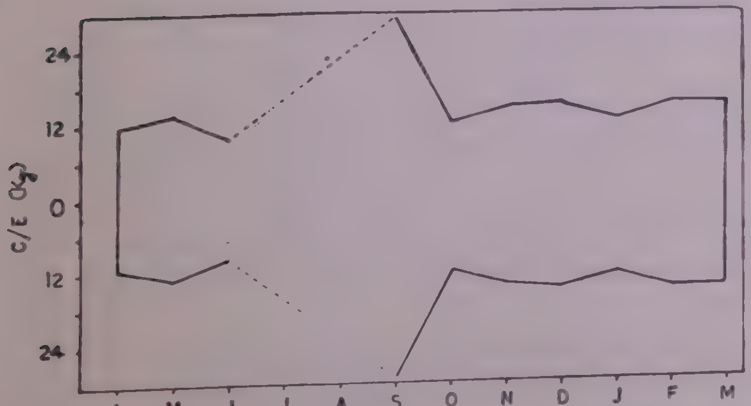

Fig. 32. Seasonal abundance of sciaenids landed by trawl net.

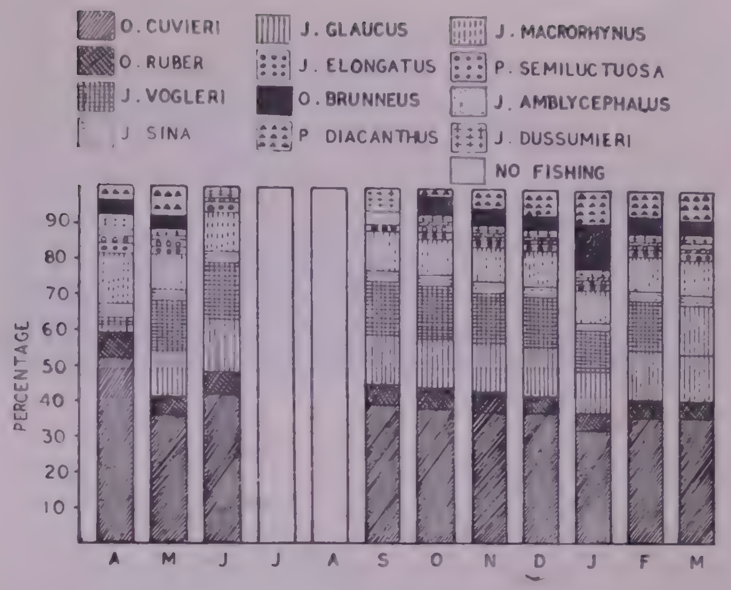

Fig. 33. Monthly species composition of sciaenids in the trawl catch.

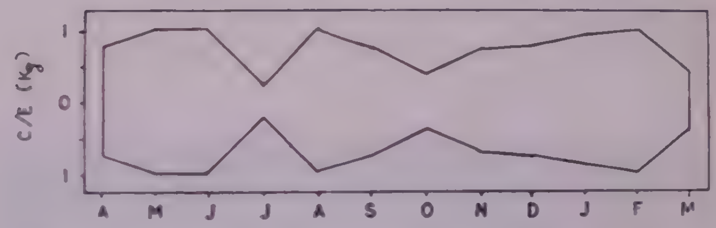

Fig. 34. Seasonal abundance of sciaenids landed by gill net.

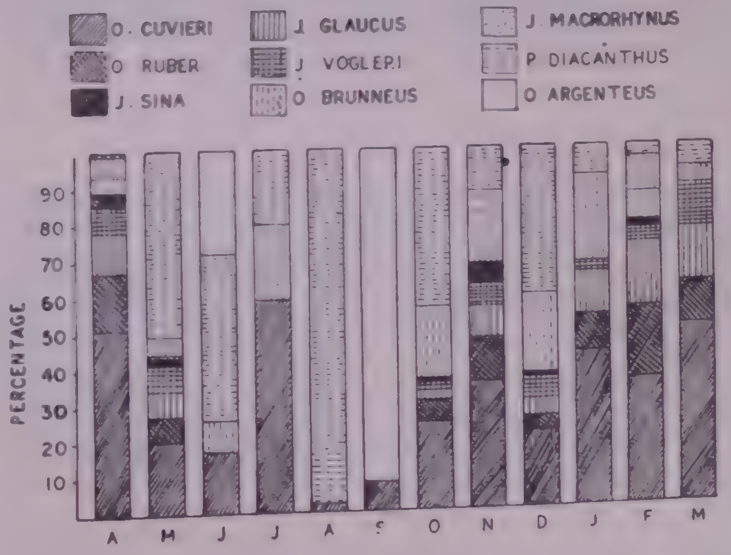

Fig. 35. Monthly species composition of sciaenids in the gill net catch.

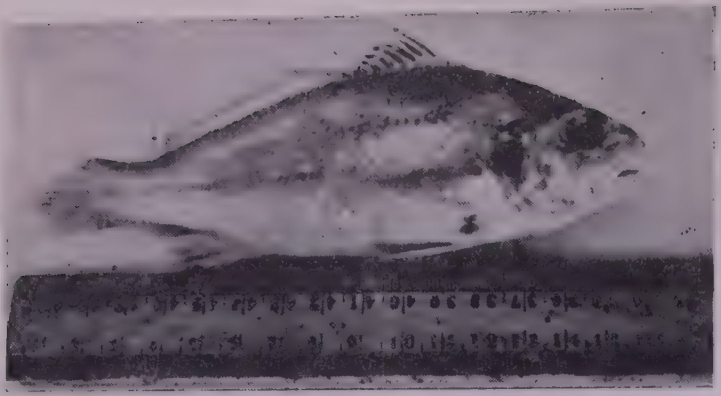

Fig. 36. *Johnieops sina.*

Scientific Name	:	*Johnieops sina*
Vernacular Name	:	'Dhoma'
Gear	:	Trawl net
Percentage in the catch of the group	:	—
Peak period of occurrence	:	Oct. – Apr.
Depth of occurrence	:	60 m
Length range in commercial fishery	:	150 - 200 mm
Size at first maturity	:	—
Spawning season	:	—

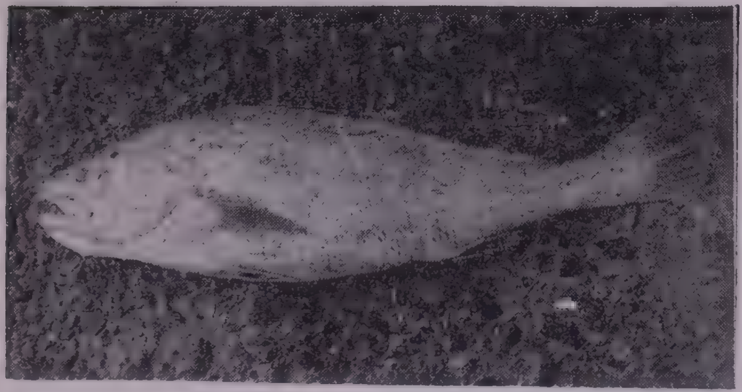

Fig. 37. *Protonibea diacanthus.*

Scientific Name	:	*Protonibea diacanthus*
Vernacular Name	:	'Ghol'
Gear	:	Trawl net/Gill net
Percentage in the catch of the group	:	Trawl net : 8.2 Gill net : 9.6
Peak period of occurrence	:	Dec. – Jan.
Depth of occurrence	:	30 – 40 m
Length range in commercial fishery	:	200 – 400 mm
Size at first maturity	:	—
Spawning season	:	—

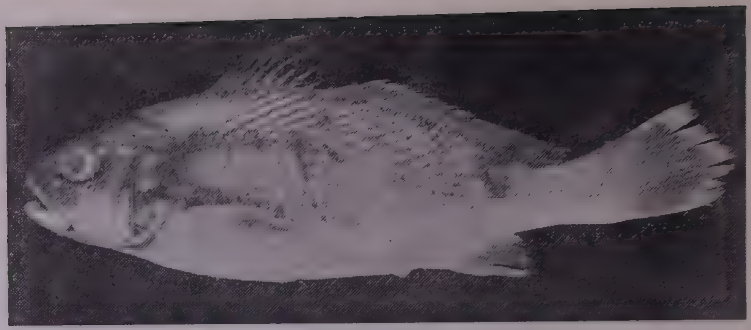

Fig. 38. *Johnius vogleri.*

Scientific Name	:	*Johnius vogleri*
Vernacular Name	:	'Dhoma'
Gear	:	Trawl net/Gill net
Percentage in the catch of the group	:	Trawl net : 10.2 Gill net : 8.2
Peak period of occurrence	:	Oct. – Mar.
Depth of occurrence	:	10 – 40 m
Length range in commercial fishery	:	150 – 200 mm
Size at first maturity	:	170 mm
Spawning season	:	Jun. – Jul. and Oct. – Nov.

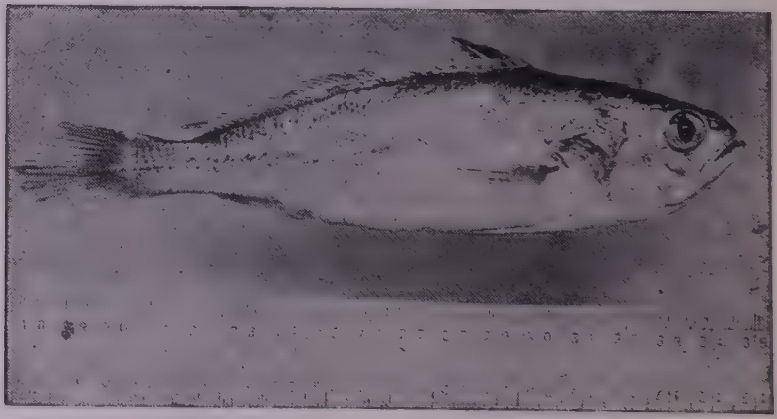

Fig. 39. *Otolithes ruber*

Scientific Name	:	*Otolithes ruber*
Vernacular Name	:	'Dhoma'
Gear	:	Trawl net/Gill net
Percentage in the catch of the group	:	Trawl net : 6.2 Gill net : 18.1
Peak period of occurrence	:	Oct. – Mar.
Depth of occurrence	:	10 – 40 m
Length range in commercial fishery	:	150 – 240 mm
Size at first maturity	:	—
Spawning season	:	—

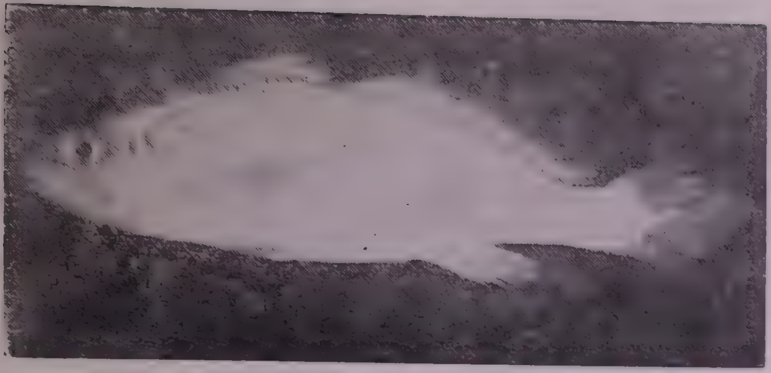

Fig. 40. *Otolithes cuvieri.*

Scientific Name : *Otolithes cuvieri*
Vernacular Name : 'Dhoma'
Gear : Trawl net/Gill net
Percentage in the catch of the group : Trawl net : 35.5
Gill net : 30.6
Peak period of occurrence : Oct. - Jan. and Mar. - May
Depth of occurrence : 10 - 40 m
Length range in commercial fishery : 150 – 250 mm
Size at first maturity : 150 – 180 mm
Spawning season : Nov. – Apr.

SCOMBRIDAE

Popular English Name : Seer fishes/Tuna/Sail fish/Mackerel
Vernacular Name (Gujarati) : 'Chopri'/'Surmi'/'Gedara'/'Goda'/'Kunga/'Bangada'
Annual average catch : 905.7 t
Percentage in total catch : 2.1
Fishing methods and their contribution : Gill net/
Trawl net: —

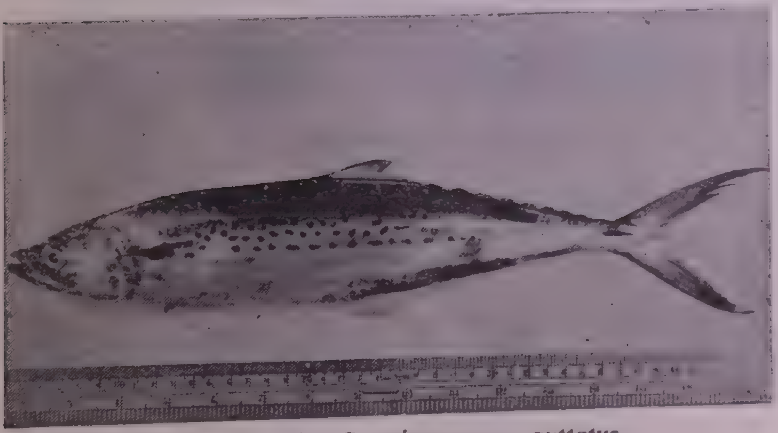

Fig. 41. *Scomberomorus guttatus.*

Scientific Name : *Scomberomorus guttatus*
Vernacular Name : 'Chopri'
Gear : Gill net/Trawl net
Percentage in the catch of the group : —
Peak period of occurrence : Jul. – Mar.
Depth of occurrence : 40 – 80 m
Length range in commercial fishery : 200 – 500 mm
Size at first maturity : —
Spawning season : —

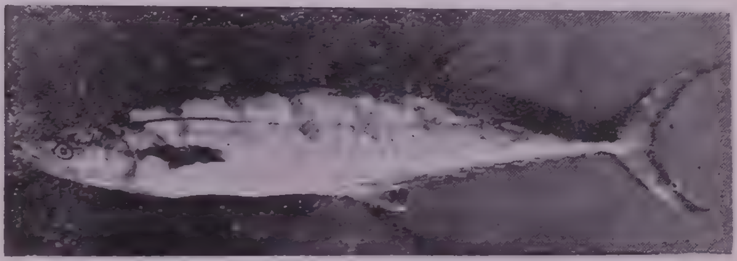

Fig. 42. *Scomberomorus commerson.*

Scientific Name : *Scomberomorus commerson*
Vernacular Name : 'Surmi'/'Chopri'
Gear : Gill net/Trawl net
Percentage in the catch of the group : —
Peak period of occurrence : Jul. – Mar.
Depth of occurrence : 40 – 80 m
Length range in commercial fishery : 300 - 900 mm
Size at first maturity : —
Spawning season : —

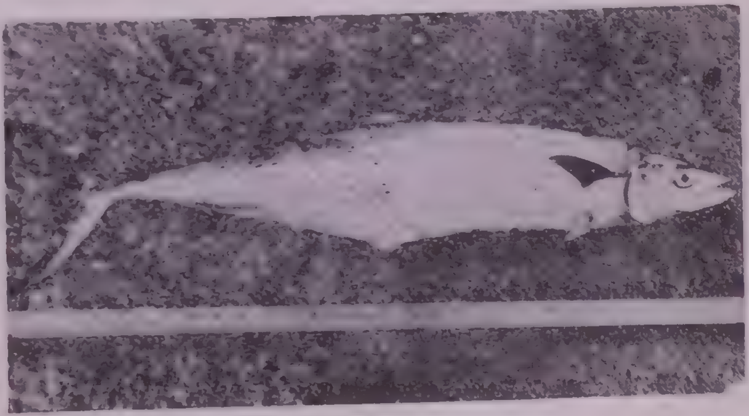

Fig. 43. *Scomberomorus lineolatus.*

Scientific Name : *Scomberomorus lineolatus*
Vernacular Name : 'Chopri'
Gear : Gill net/Trawl net
Percentage in the catch of the group : —
Peak period of occurrence : Jul. – Mar.
Depth of occurrence : 40 – 80 m
Length range in commercial fishery : 400 – 700 mm
Size at first maturity : —
Spawning season : —

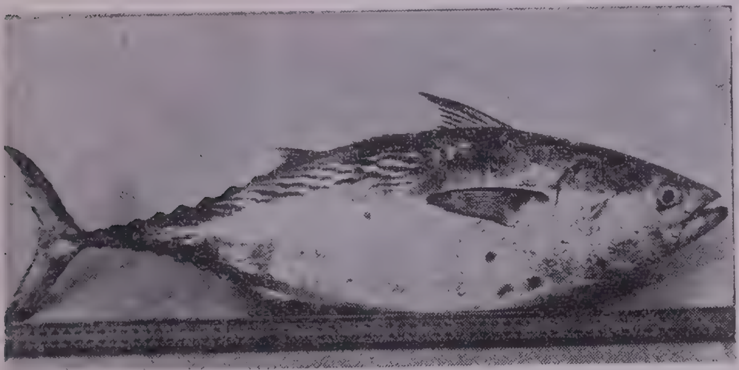

Fig. 44. *Euthynnus affinis.*

Scientific Name : *Euthynnus affinis*
Vernacular Name : 'Gedara'
Gear : Gill net
Percentage in the catch of the group : —
Peak period of occurrence : Oct. – Mar.
Depth of occurrence : 40 m
Length range in commercial fishery : 400 – 600 mm
Size at first maturity : —
Spawning season : —

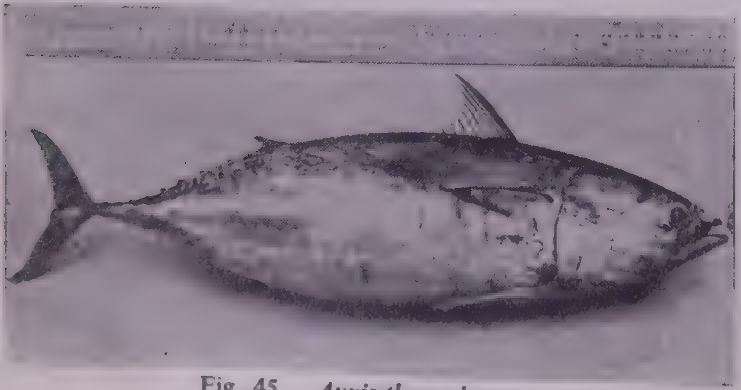

Fig. 45. *Auxis thazard.*

Scientific Name : *Auxis thazard*
Vernacular Name : 'Gedara'
Gear : Gill net
Percentage in the catch of the group : —
Peak period of occurrence : Oct. – Mar.
Depth of occurrence : 40 m
Length range in commercial fishery : 300 – 400 mm
Size at first maturity : —
Spawning season : —

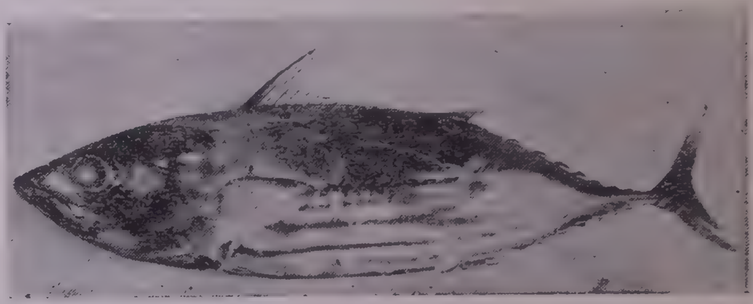

Fig. 46. *Katsuwonus pelamis.*

Scientific Name : *Katsuwonus pelamis*
Vernacular Name : 'Gedara'
Gear : Gill net
Percentage in the catch of the group : —
Peak period of occurrence : Oct. – Mar.
Depth of occurrence : 40 m
Length range in commercial fishery : 400 – 800 mm
Size at first maturity : —
Spawning season : —

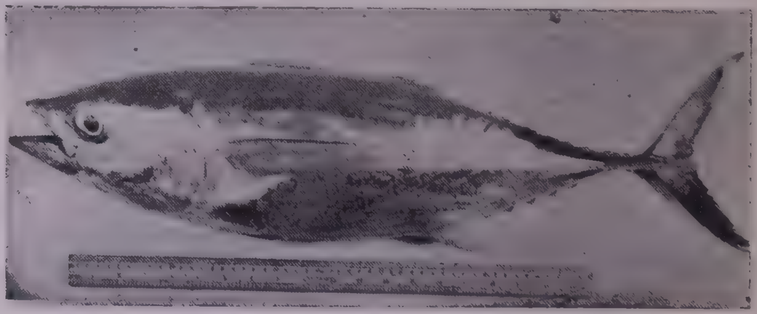

Fig. 47. *Thunnus albacares.*

Scientific Name : *Thunnus albacares*
Vernacular Name : 'Gedara'
Gear : Gill net
Percentage in the catch of the group : —
Peak period of occurrence : Oct. – Mar.
Depth of occurrence : 40 m

Length range in commercial fishery : 1,000 – 1,500 mm
Size at first maturity : —
Spawning season : —

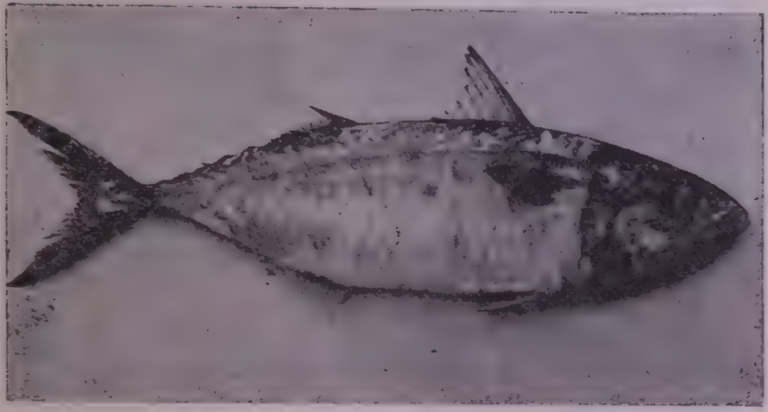

Fig. 48. *Rastrelliger kanagurta.*

Scientific Name : *Rastrelliger kanagurta*
Vernacular Name : 'Bangada'
Gear : Trawl net/Gill net
Percentage in the catch of the group : —
Peak period of occurrence : —
Depth of occurrence : 40 – 60 m
Length range in commercial fishery : —
Size at first maturity : —
Spawning season : —

SERRANIDAE

Popular English Name : Rock Cods/Grouper
Vernacular Name (Gujarati) : 'Wehali'/'Wekhra'
Annual average catch : 115.4 t
Percentage in total catch : 0.3
Fishing methods and their contribution : Gill net/
Trawl net: —

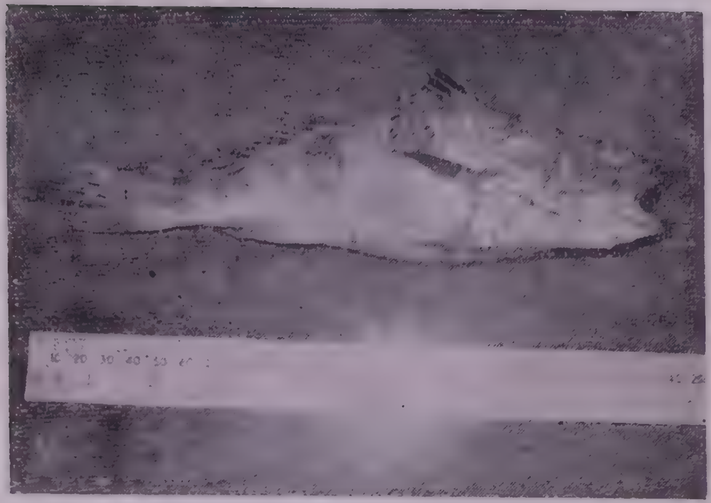

Fig. 49. *Epinephelus malabaricus.*

Scientific Name : *Epinephelus malabaricus*
Vernacular Name : 'Wehali'
Gear : Trawl net/Gill net
Peak period of occurrence : Nov. – Dec.
Depth of occurrence : 20 – 80 m
Length range in commercial fishery : 1,000 – 1,500 mm
Size at first maturity : —
Spawning season : —

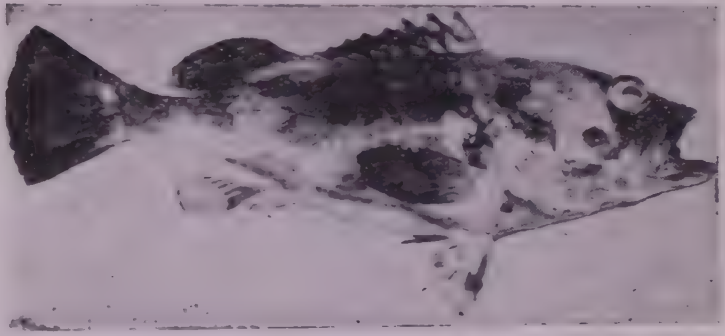

Fig. 50. *Epinephelus diacanthus.*

Scientific Name : *Epinephelus diacanthus*
Vernacular Name : 'Wehali'
Gear : Trawl net
Percentage in the catch of the group : —
Peak period of occurrence : Nov. – Dec.
Depth of occurrence : 20 – 80 m
Length range in commercial fishery : 150 – 350 mm
Size at first maturity : —
Spawning season : —

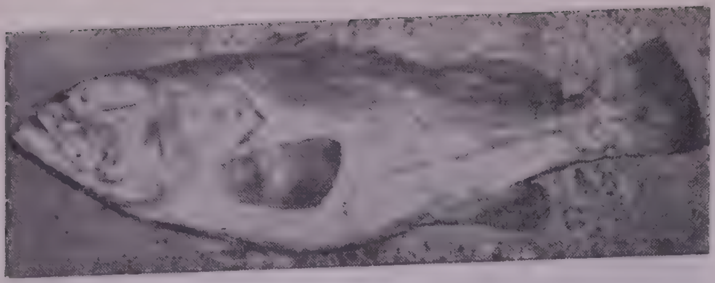

Fig. 51. *Epinephelus tauvina.*

Scientific Name : *Epinephelus tauvina*
Vernacular Name : 'Wekhra'
Gear : Trawl net
Percentage in the catch of the group : —
Peak period of occurrence : Nov. – Dec.
Depth of occurrence : 20 – 60 m
Length range in commercial fishery : 400 – 650 mm
Size at first maturity : —
Spawning season : —

Sparidae

Popular English Name : Silver breams
Vernacular Name (Gujarati) : 'Kishi'
Annual average catch : 118.9 t
Percentage in total catch : 0.4
Fishing methods and their contribution : Trawl net: —

Sphyraenidae

Popular English Name : Barracuda
Vernacular Name (Gujarati) : 'Bhugar'/'Zeera'
Annual average catch : 6.3 t
Percentage in total catch : 0.01
Fishing methods and their contribution : Trawl net: —

Stromateidae

Popular English Name : Pomfrets
Vernacular Name (Gujarati) : 'Paplet'/'Vichuda'/'Alwa'/'Pathi'/'Kafri'
Annual average catch : 684.9 t
Percentage in total catch : 1.5
Fishing methods and their contribution : Gill net/Trawl net: —

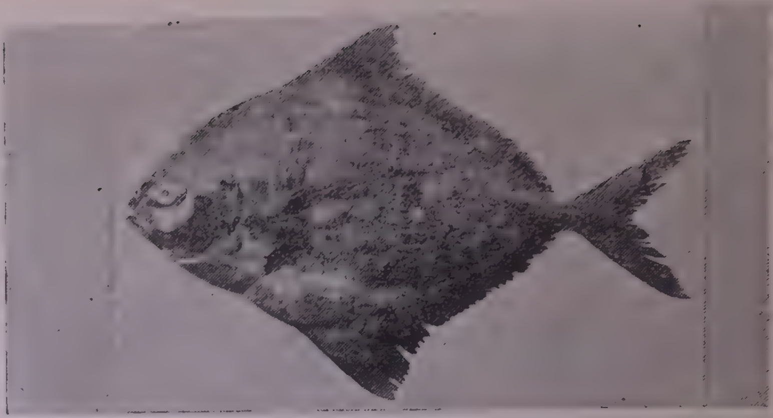

Fig. 52. *Parastromateus niger.*

Scientific Name : *Parastromateus niger*
Vernacular Name : 'Alwa'
Gear : Gill net/Trawl net
Percentage in the catch of the group : —
Peak period of occurrence : Apr. - Jun.
Depth of occurrence : 20 – 40 m
Length range in commercial fishery : 100 – 400 mm
Size at first maturity : —
Spawning season : —

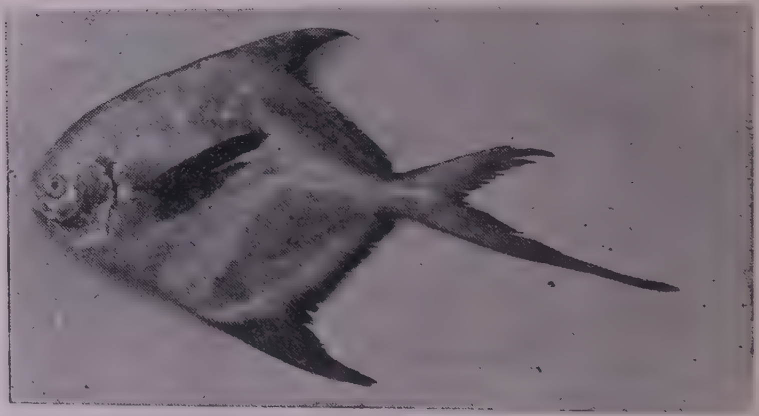

Fig. 53. *Pampus argenteus.*

Scientific Name : *Pampus argenteus*
Vernacular Name : 'Paplet'/'Vichuda'
Gear : Gill net
Percentage in the catch of group : —
Peak period of occurrence : May – Jun.
Depth of occurrence : 20 – 30 m
Length range in commercial fishery : 100 - 300 mm
Size at first maturity : —
Spawning season : —

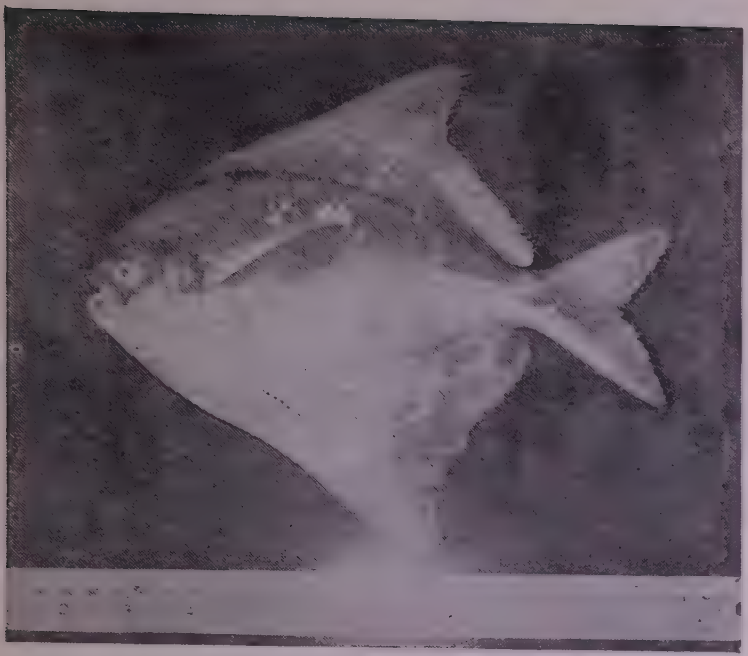

Fig. 54. *Pampus chinensis.*

Scientific Name : *Pampus chinensis*
Vernacular Name : 'Pathi'/'Kafri'
Gear : Gill net
Percentage in the catch of the group : —
Peak period of occurrence : —
Depth of occurrence : 20 – 40 m
Length range in commercial fishery : 250 – 350 mm
Size at first maturity : —
Spawning season : —

SYNODONTIDAE

Popular English Name : Lizard fishes
Vernacular Name (Gujarati) : 'Chor bumla'
Annual average catch : 115.5 t
Percentage in total catch : 0.3
Fishing methods and their contribution : Trawl net: —

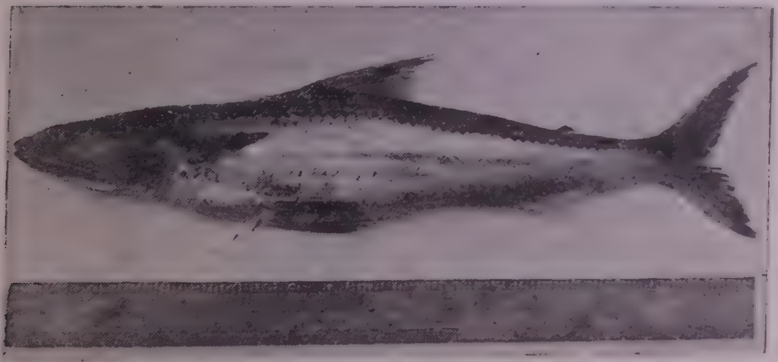

Fig. 55. *Saurida tumbil.*

Scientific Name : *Saurida tumbil*
Vernacular Name : 'Chor bumla'
Gear : Trawl net
Percentage in the catch of the group : 100
Peak period of occurrence : Nov. – Jan.
Depth of occurrence : 40 – 80 m
Length range in commercial fishery : 300 – 400 mm
Size at first maturity : —
Spawning season : —

TACHYSURIDAE

Popular English Name : Cat fishes
Vernacular Name (Gujarati) : 'Khaga'
Annual average catch : 722.1 t
Percentage in total catch : 1.6
Fishing methods and their contribution : Trawl net : 1.1%
Gill net : 0.5%

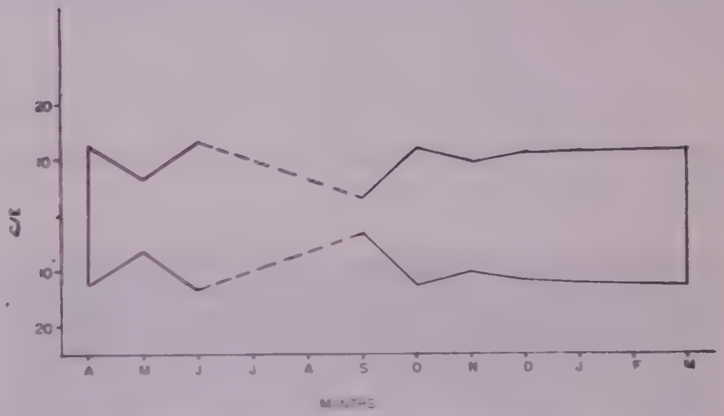

Fig. 56 Seasonal abundance of cat fish landed by trawl net.

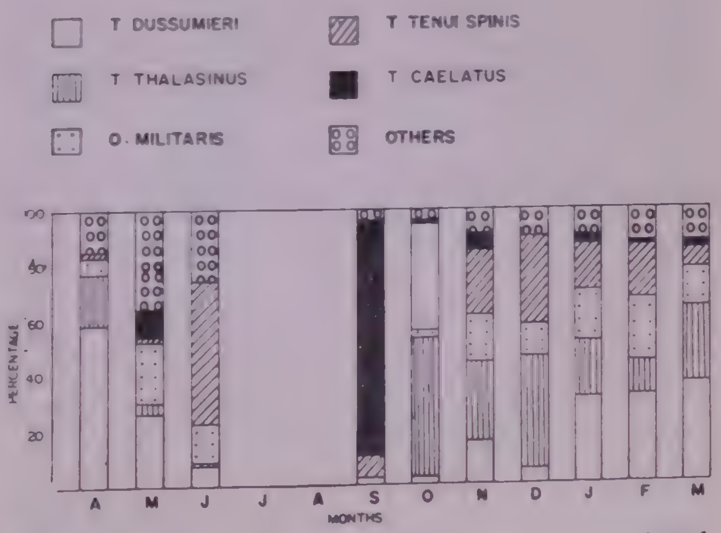

Fig. 57. Monthly species composition of cat fish in the trawl catch.

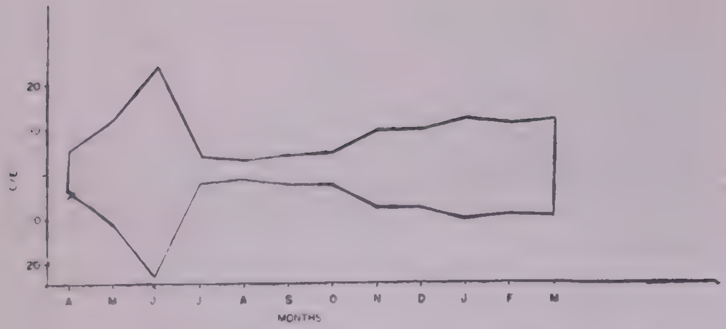

Fig. 58. Seasonal abundance of cat fish landed by gill net.

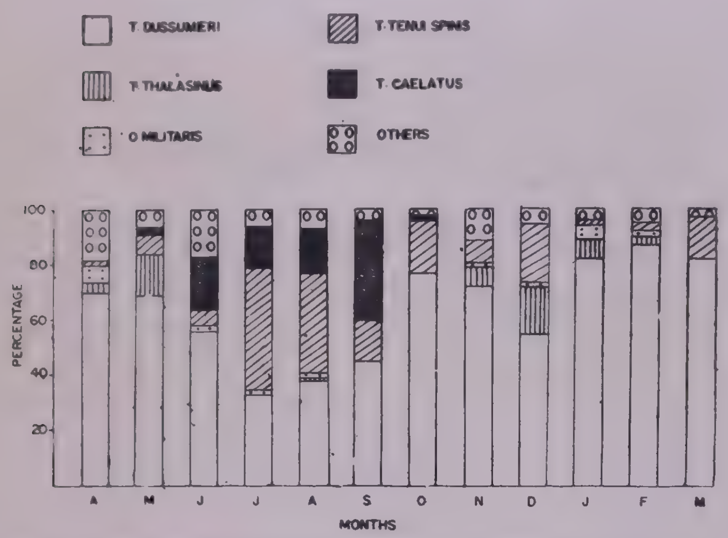

Fig. 59 Monthly species composition of cat fish in the gill net catch.

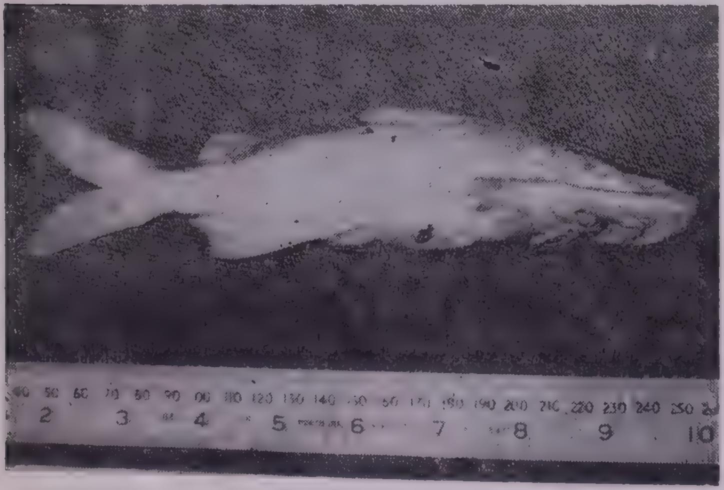

Fig. 60. *Osteogeneiosus militaris.*

Scientific Name	:	*Osteogeneiosus militaris*
Vernacular Name	:	'Khaga'
Gear	:	Trawl net/Gill net
Percentage in the catch of the group	:	Trawl net : 13.3 Gill net : 2.0
Peak period of occurrence	:	Jan. – May
Depth of occurrence	:	20 – 60 m
Length range in commercial fishery	:	240 – 490 mm
Size at first maturity	:	—
Spawning season	:	—

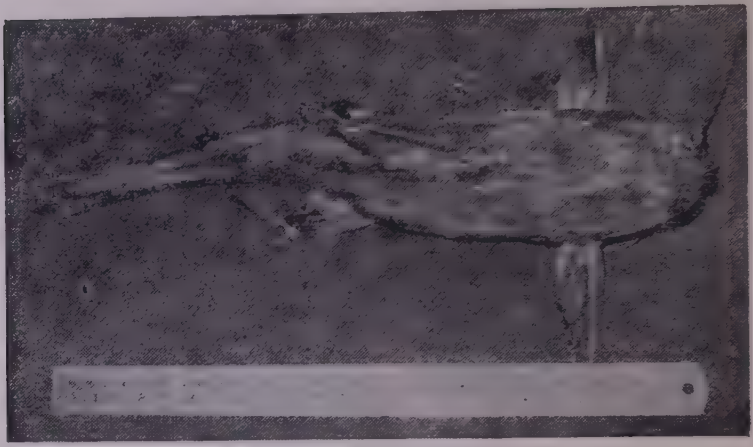

Fig. 61. *Tachysurus sona.*

Scientific Name	:	*Tachysurus sona*
Vernacular Name	:	'Khaga'
Gear	:	Trawl net/Gill net
Percentage in the catch of the group	:	—
Peak period of occurrence	:	—
Depth of occurrence	:	30 - 60 m
Length range in commercial fishery	:	600 - 700 mm
Size at first maturity	:	—
Spawning season	:	—

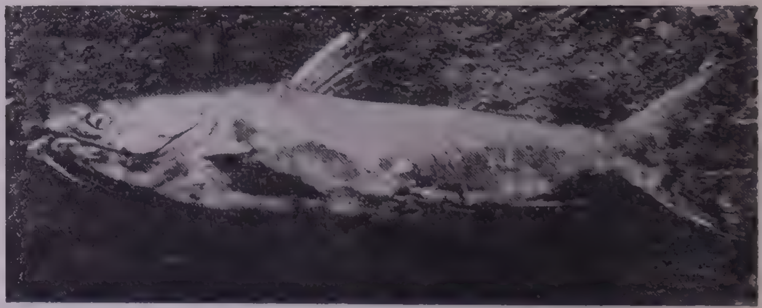

Fig. 62. *Tachysurus tenuispinis.*

Scientific Name	:	*Tachysurus tenuispinis*
Vernacular Name	:	'Khaga'
Gear	:	Trawl net/Gill net
Percentage in the catch of the group	:	Trawl net : 17.9 Gill net : 9.5
Peak period of occurrence	:	Jan. – Apr. and Jun.
Depth of occurrence	:	20 – 60 m

Length range in commercial fishery : 260 – 590 mm
Size at first maturity : —
Spawning season : Dec. – Apr.

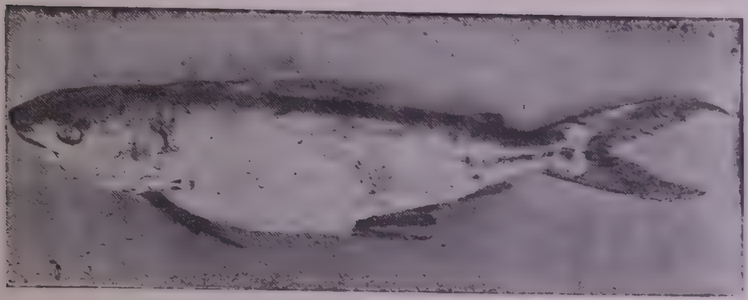

Fig. 63. *Tachysurus thalassinus.*

Scientific Name : *Tachysurus thalassinus*
Vernacular Name : 'Khaga'
Gear : Trawl net/Gill net
Percentage in the catch of the group : Trawl net : 26.5
Gill net : 5.8
Peak period of occurrence : May – Dec.
Depth of occurrence : 20 – 30 m
Length range in commercial fishery : 260 – 550 mm
Size at first maturity : —
Spawning season : Oct. – Mar.

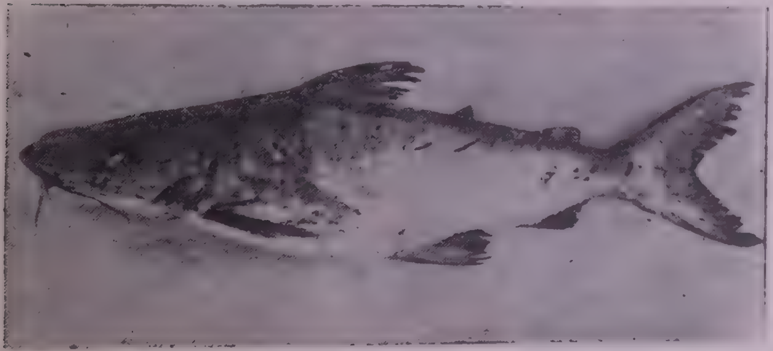

Fig. 64. *Tachysurus dussumieri.*

Scientific Name : *Tachysurus dussumieri*
Vernacular Name : 'Khaga'
Gear : Trawl net/Gill net
Percentage in the catch of the group : Trawl net : 37.5
Gill net : 72.4
Peak period of occurrence : Jan. – May
Depth of occurrence : 20 – 60 m
Length range in commercial fishery : 300 – 750 mm
Size at first maturity : —
Spawning season : —

TRICHIURIDAE

Popular English Name : Ribbon fish
Vernacular Name (Gujarati) : 'Pathi'/'Baga'
Annual average catch : 11,081.8 t
Percentage in total catch : 24.8
Fishing methods and their contribution : Trawl net/
Dol net : —

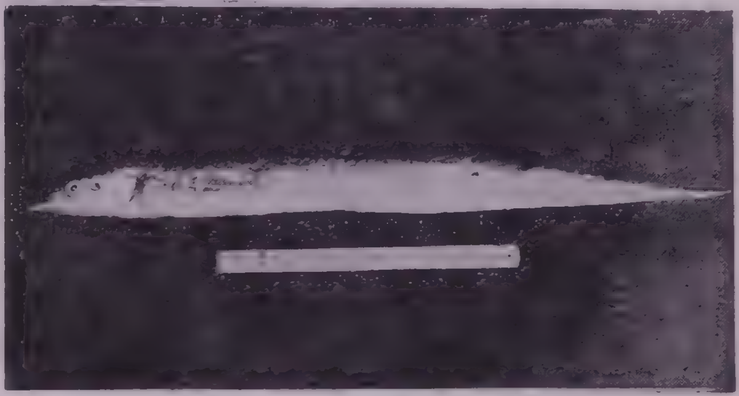

Fig. 65. *Trichiurus lepturus.*

Scientific Name : *Trichiurus lepturus*
Vernacular Name : 'Baga'
Gear : Trawl net/Dol net
Percentage in the catch of the group : --
Peak period of occurrence : Dec. – Feb.
Depth of occurrence : 40 – 80 m
Length range in commercial fishery : 300 – 1,200 mm
Size at first maturity : —
Spawning season : —

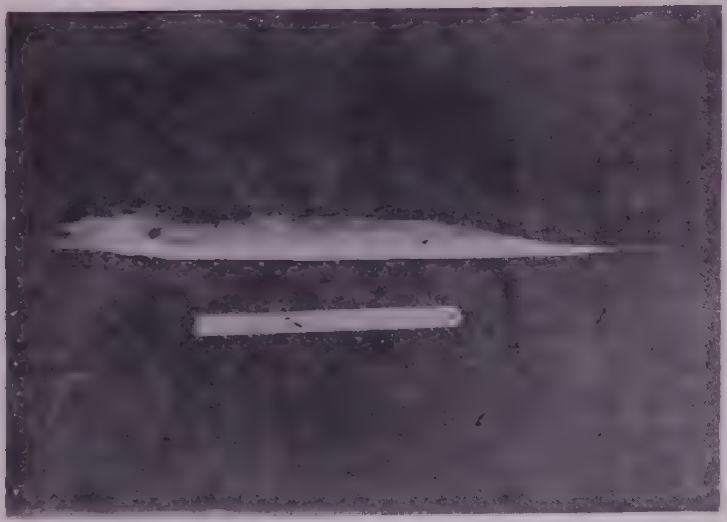

Fig. 66. *Lepturacanthus savala.*

Scientific Name : *Lepturacanthus savala*
Vernacular Name : 'Pathi'
Gear : Trawl net/Dol net
Percentage in the catch of the group : —
Peak period of occurrence : Dec. – May

Depth of occurrence : 40 – 80 m
Length range in commercial fishery : 300 – 900 mm
Size at first maturity : —
Spawning season : —

SPONGE-GENERATED BIOEROSION IN LAKSHADWEEP

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Introduction

The discovery of *Cliona celata* by Grant in 1826 from characteristic galleries made inside the oyster shell triggered off a long-lasting debate on the role played by sponges in bioerosion. Subsequent investigations on this species as well as its congeners have proved beyond doubt that not only species belonging to the genus *Cliona* but also species belonging to the genera such as *Thoosa*, *Spirastrella*, *Halina* and *Samus* are capable of excavating into calcium carbonate material such as shell, coral, calcareous algae *etc*. The part played by sponges in the destruction of gregarious molluscan beds and coral reefs has been well documented in the past, and as understood at present, the sponges constitute a major group among 12 different taxa of marine plants and animals that cause considerable damage in the marine environment.

Calcibiocavitological investigations made in the past indicate that various borers resort to various methods in gaining entry into the hard calcareous substrate. In some it may be by chemical means and in others, by mechanical means. In yet others it is effected by a combination of both the above means. The present article gives an account of the author's findings on sponge generated bioerosion in the coral islands of Lakshadweep.

Factors influencing bioerosion

It has been shown that when a coral piece infested with boring sponge is cut into two bits it will stimulate the boring activity in the resultant bits considerably. Boring animals and also human intervention by way of cutting channels across the reef *etc*. in Lakshadweep may accelerate the boring activity of sponges already existing.

Illumination plays an important role in the boring activity of sponges. It has been experimentally proved that calcite blocks infested with *Cliona* sp., when illuminated by low voltage microscope lamp started producing calcareous chips at a higher rate. The clarity of water in the various lagoons of Lakshadweep is exceptional (euphotic zone is about 90 m) when compared with any other coastal areas of the mainland and this may be taken as one of the reasons for the abundance of boring sponges in Lakshadweep. Besides the factors mentioned above, water movement and also the temperature conditions have some effect on the activity of boring sponges.

Structure and composition of the boring sponge population in Lakshadweep

An interesting aspect noted with regard to the sponge fauna of the various islands in the Lakshadweep is the abundance of boring species over nonboring species. This is not only with regard to the total number of species represented in each island but also with the number of species collected from each collection site along the various morphozones investigated. In some collection spots only boring species were represented. The percentage distribution of boring species in relation to the total number of species collected from each island is given in Table 1.

Table 1. *Distribution of boring sponges in the various islands surveyed (in %)*

Island	Boring sponges
1. Kavaratti	46.4
2. Kalpeni	36.1
3. Suheli	48.3
4. Androth	66.6
5. Minicoy	50.0
6. Amini	38.4
7. Kiltan	20.0
8. Agathi	60.0
9. Kadamath	58.3

The total number of boring species recorded from the various islands in Lakshadweep is 18 and these may be classified under 4 orders, 5 families and 9 genera of the Phylum Porifera. The genera represented and the number of species under each may be summarised as follows: *Rhabderemia* (1); *Spirastrella* (4); *Amorphinopsis* (1); *Aka* (2); *Cliona* (6); *Thoosa* (1); *Jaspis* (1); *Halina* (1) and *Samus* (1). Of the above 18 species those falling under the genus *Cliona* are widely distributed in the coral reefs of Lakshadweep and is followed by the genus *Spirastrella.*

In order to get a clear picture of the abundance of each species the total incidence by various species in each island was calculated for five islands. From this the percentage incidence of each species was found out and the same is furnished below graphically (Fig. 1).

The graphs indicate that *Cliona celata* is the dominant species in two islands (Kavaratti and Suheli), *C. ensifera* in Kalpeni and *C. mucronata* in Androth. The Minicoy Island offers an altogether different picture since both *C. celata* and *C. vastifica* are equally abundant.

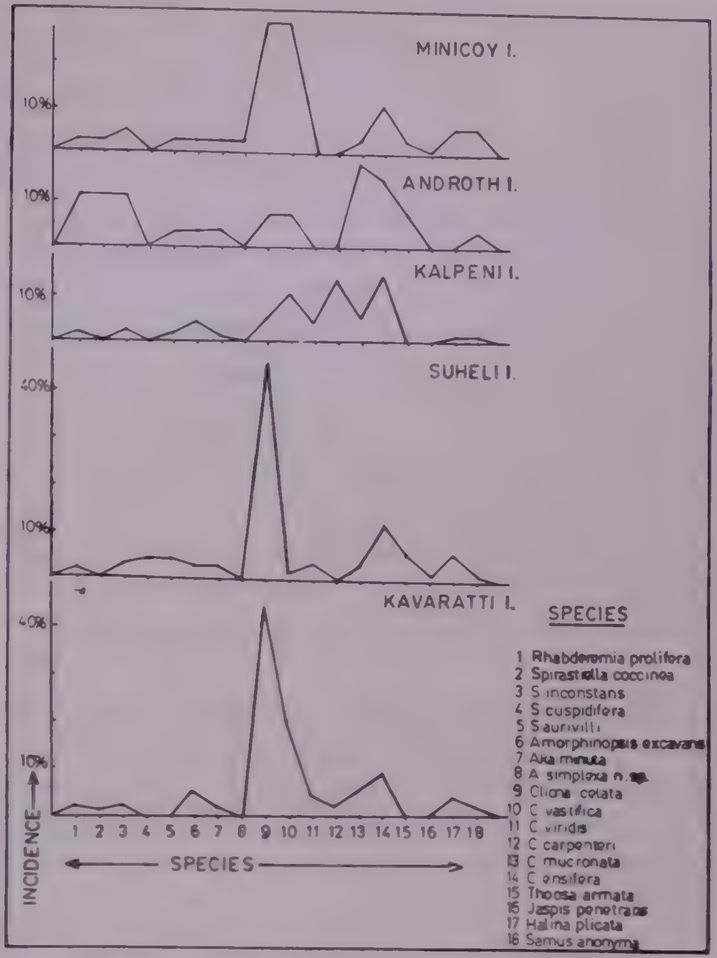

Fig. 1. Incidence indices (%) of 18 species of boring sponges from five islands in the Lakshadweep.

Four species of the genus *Spirastrella* are found to occur in the different islands surveyed, of which two *viz. S. inconstans* and *S. cuspidifera* show the tendency to overgrow the substratum after disintegrating it totally. These two species usually infest massive corals; both dead and alive, which may not project out much from the sea floor. When the substratum is totally disintegrated the upper part of the sponge grows into massive lobate structure bearing excurrent and incurrent openings. This overgrowth may be compared with the gamma stage in the growthform of *C. celata.* (But this growthform is never seen for *C. celata* in Indian waters.)

S. inconstans exhibits the habit of producing asexual bodies from the surface as well as from the tip of tubular branches in advanced stages. These asexual bodies get nipped off from the parent sponge and float in water indefinitely. On reaching a suitable substratum these bodies may get anchored to it and form new colonies.

The abundance of coralline sand in lagoons is an added advantage to this species for its spreading in the various lagoons surveyed.

Summarising the distribution of *C. ensifera* and *C. mucronata* it may be stated both in the light of present investigation as also from the data amassed in the past from the coral reefs of the Gulf of Mannar, Palk Bay and southwest coast of Kerala that these two species are typical coral boring species and are seldom encountered in molluscan shells. In Lakshadweep lagoons also these species are widely distributed and in Androth *C. mucronata* forms the dominant species incidence-wise, while in Kalpeni *C. ensifera* dominates. In these two lagoons the activity of *C. celata* and *C. vastifica* is seen at a lower level. It is not sure whether the activity of *C. mucronata* and *C. ensifera* is checking the activity of *C. celata* and *C. vastifica* or not, but a careful examination of the incidence pattern for various islands presented in Fig. 1 clearly indicates that there is severe competition for space between these two groups of species.

The other boring species represented in Fig. 1 are of no significance at present from the point of incidence. But judging from the behaviour pattern of boring sponges in general it is possible that any species can enter into a quiescent stage after an outburst and as such any species which is inactive today can prove to be dangerous after a few years.

It is quite interesting to note that both *Cliona margaritifera* and *C. lobata,* which have reappeared in the molluscan beds of the southwest coast of India around 1980 after a very long quiescent stage, have not yet made their appearance in the Lakshadweep group of islands. Since their first appearance at Vizhinjam around 1980, these two species have migrated to almost all the important gregarious molluscan beds of that area (Thomas *et al.*, 1983. *Mar. Fish. Infor. Serv., T & E Ser.*, **49**, 1-13). Both these species are potentially dangerous as they can cause wide spread depletion of the molluscan beds as has been reported from Ceylon (Sri Lanka) around 1902. There is every possibility that the larvae of these species may get swept off to Lakshadweep through the currents prevailing off the west coast of India. But such a migration will be very slow and hence is not a matter of immediate concern. On the contrary any attempt on the part of man to transport a few infected live specimens of pearl oyster, edible oyster, mussel or any other molluscan species to Lakshadweep for cultivation can cause immediate and far reaching repurcussions in the ecological equilibrium which is prevailing there at present. Hence, any consignment of cultivable mollusc from mainland or elsewhere to Lakshadweep must be screened properly before it is despatched.

Damage caused to corals

Details pertaining to the rate of mortality of corals in five islands (Kavaratti, Suheli, Kalpeni, Androth and Minicoy) were collected on a transect/morphozone basis and are furnished elsewhere in this paper. Examination of the sample collected from different lagoons indicates that sponge plays an important role in the death of corals everywhere.

It has been found that sponges can bore into both dead and living corals. Since boring sponges obtain their food from sources other than the host, the death of coral (host) will never affect the sponge adversely. And as such the chipping of calcium carbonate matter can go on incessantly even after the death of coral. The galleries formed inside the coral by the removal of calcareous particles weaken the entire reef framework making it more susceptible to the wear and tear caused by waves. Such a weakened substratum may also accelerate the activity of secondary borers such as polychaetes, molluscs, sipunculids and echinoderms.

Boring sponges make extensive galleries inside the substratum, but the upper stratum of corals and both upper and lower strata of shells remain practically untouched and more or less intact except for a few pores for the incurrent and excurrent papillae to project out. Hence the actual damage caused to shell or coral cannot be assessed by external examination alone. When the inroads of *Cliona* reach the climax stage the interior of the coral becomes practically hollow except for a few pillars of calcium carbonate matter stretching across the cavities. In branching corals a continuous cavity running length-wise, may even be seen (Fig. 3 E, F.) inside every branch infected.

Continuous chipping of calcium carbonate matter from the substratum can cause a decrease in the total weight of the substratum. It has been experimentally shown that in new colonies the boring activity of sponge will be quite intense but subsequently the substratum limitation and competition for food retard the activity considerably. Besides these, the sponge will have to set apart some energy for nutrient storage and reproduction also. It is calculated that in such cases the calcium carbonate removed from the original calcareous object is only about 50% of the total. In such species the question of disintegrating the substratum totally does not arise, but in species such as *Cliona celata, Spirastrella inconstans* and *S. cuspidifera,* the sponge at a later stage, becomes massive and overgrow the substratum (gamma stage) just like any other sponge. Hence, the capacity to disintegrate the substratum fully or partly in the early stage of its life history is a factor which governs its future morphology.

In order to evaluate the damage caused to coral colonies by boring sponges, data were collected separately for branching and massive forms. In the case of branching species boring intensity, in both stalk portion and branches, was assessed and the conclusion arrived at may be given as follows:

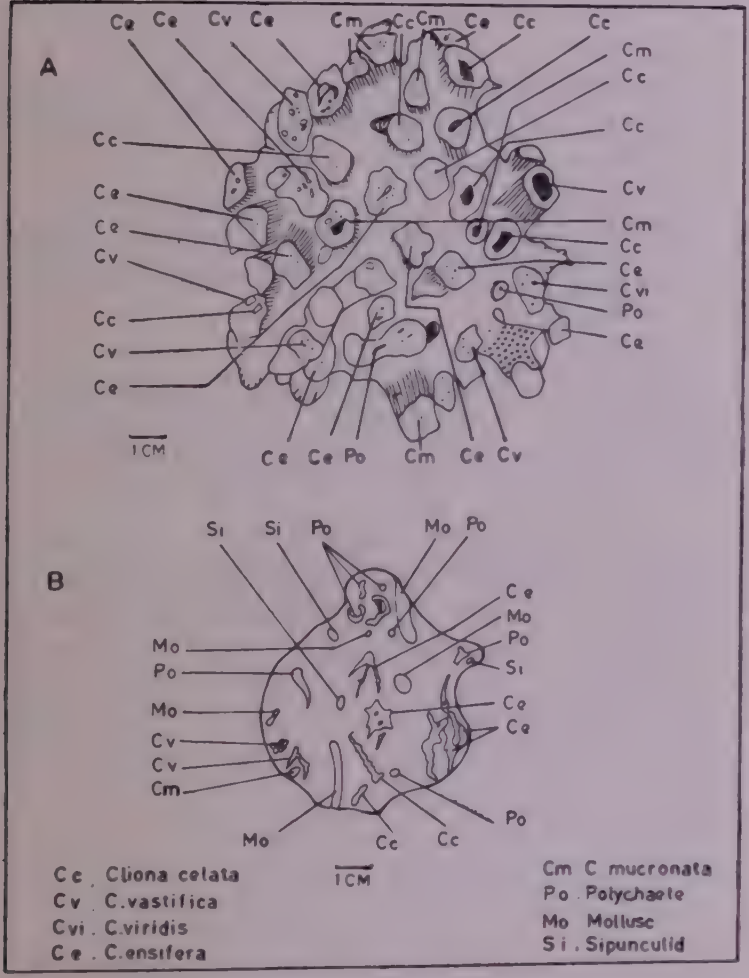

Fig. 2.

A. Diagramatic representation of a branching coral *(Acropora* sp.) collected from morphozone E_8 of Kavaratti Island to show the distribution and boring pattern of the various boring organisms.

B. Diagramatic representation of the stalk of a branching coral *(Acropora* sp.) collected from morphozone J_6 in Kavaratti reef system to show the distribution and boring pattern of the various boring organisms.

A. **Branching coral** *(Acropora* sp.*)*

(a) *Branches of* Acropora *sp.*

An *Acropora* colony (Fig. 2A) weighing 600 g with a maximum diameter of 15 cm bearing 48 upright branches arising from a flat basal portion was collected from Kavaratti (E_8) and was studied in detail for the species composition and intensity of boring. Branches were in a partly dead condition and when broken it was noted that most of them harboured boring sponge inside. Out of 48 branches, 34 (70.8%) were found infected with boring sponges. Other borers, mainly polychaetes and sipunculids, could also be noticed on some of these branches. The total number of boring organisms occupying the cut end of each branch was calculated and from this the incidence index of each species/group was prepared (*i.e.* percentage in total incidence). Sponge represented belonged to five species, and the distribution of various species/groups is given in Table 2.

Table 2. *Incidence indices of various boring organisms on the branches of* Acropora *sp.*

Species/groups	Number		% of incidence	
Sponge				
C. ensifera	12	34	30.7	87.2
C. celata	11		28.2	
C. mucronata	6		15.4	
C. vastifica	4		10.3	
C. viridis	1		2.6	
Polychaete	2		5.1	
Mollusc	2		5.1	
Sipunculid	1		2.6	
Total	39*			

* Multiple infection in some

The above Table indicates that sponge, as a group, dominated (87.2%) among the various groups of boring organisms that destroy coral colonies in Lakshadweep. The above Table also shows that the incidence noted for different species of boring sponges on this coral colony is not in full agreement with that seen for the whole island (compare Fig. 1 giving the incidence index for the island Kavaratti). In the projection for the entire island *Cliona celata* and *C. vastifica* ranked first and second respectively, while in the coral colony now investigated, species such as *C. ensifera, C. celata* and *C. mucronata* occupied the first three ranks respectively.

Based on the area occupied by different species of sponges on coral branches it may be stated that the etchings of *C. celata* occupy a larger area when compared to those made by other boring sponges. This species can fully fill the interior of any branch with its tunnels and chambers, and in this respect the damage done to coral is much more intense than that caused by any other species of sponge. The cavities made by both *C. mucronata* and *C. ensifera* assume the shape of an irregular tunnel inside the branch with little or no ramification sideways. Hence, the branches of coral infested by these two species of sponges may live for a comparatively longer period.

Pattern of boring

Based on the data collected from branching corals the pattern of boring seen in the case of *C. celata* has been studied in detail. The larva, soon after its settlement on the coral, flattens to form an encrusting mass. This is followed by the etching out of calcium carbonate particles to form an initial chamber. Further spreading of the sponge inside the coral is effected through chambers originating from the initial chamber and thus a mass of chambers is formed just inside the point of larval entry. These chambers may be seen filling the entire thickness of the branch and may open out at the other side (sometimes at several points) of the branch through the excurrent and incurrent papillae (Fig. 3A). The number of papillae increases gradually on all sides of the branch. The death of branch actually occurs from this point onwards and as a result the polyps above this point get decayed gradually. Algae may get attached to such dead branches and grow. It is noted that in all islands surveyed some filamentous algae of black colour usually colonise these dead branches giving a black, furry appearance to the branches underwater.

Further spreading of the sponge inside the coral branch takes place in a characteristic pattern. From the mass of chambers formed inside the coral (at the point where the larva gained access into the coral branch) some actively growing branches are formed by the sponge (usually 3 to 8 numbers). These branches are usually located at the periphery of the branch (of coral) very close to its outer surface. These branches (Fig. 3 B, C) usually take a linear course through the periphery of the coral possibly because of the added advantage of communicating with the surface through incurrent and excurrent papillae. Such branches of sponge may come closer to each other at a point where the diameter of the branch becomes less or at a point where the branch of coral divides to form a branchlet. Partial or total fusion of one or more of such branches of sponge may also be seen (Fig. 3 D). In an advanced stage of boring, all the peripheral branches (of sponge) become enlarged (Fig. 3 D, E) resulting in the breakdown of the calcareous material separating adjacent canals. This will produce a peripheral cavity filled with sponge encircling a central core of calcareous material (Fig. 3 E). This central core also may get disintegrated gradually resulting in a continuous central cavity filled with sponge (Fig. 3 F). At this stage the number of openings which lodge incurrent and excurrent papillae may also increase to meet the additional requirement of water for the entire colony of sponge. Since dimentional growth is not impossible inside the coral branch the sponge overcomes this situation by increasing its surface area in the following ways.

a) Papillae of similar function growing close by will fuse together forming a compound and more conspicuous structure.

b) After attaining this stage all the papillae irrespective of function get interconnected by a plate of sponge.

Further growth in this line may give rise to a massive growth outside the substratum (gamma stage). But the gamma stage is never attained in the Indian seas.

It is noted that *C. celata* prefer to grow upwards (negatively geotropic), that is, towards the distal end of each branch. The larva, when enters at the middle of any branch the disintegration and death of the branch occur from that point onwards, while the part of branch below this point remains unaffected. Coral colonies bearing distally dead branches further corroborate this point.

(b) Stalk of Acropora *sp.*

In order to get a clear picture on the magnitude of damage caused to the stalk portion of branching corals, the stalk of a branching coral *(Acropora* sp.*)* collected from Kavaratti (J_5) was studied in detail. The average diameter of the stalk is 5 cm, and the distribution of the various boring species/groups at the cut end of the stalk is diagramatically represented in Fig. 2 B. It is found that nearly 40% of the area of coral (in cross section) is being damaged by an array of boring organisms drawn up from different phyla of animal kingdom. Four species of sponges were present. The percentage incidence of various species/group is indicated in Table 3.

Table 3. *Incidence indices of various boring organisms on the stalk of* Acropora *sp.*

Species/groups	Number		% of incidence	
Sponge				
C. ensifera	3	8	13.6	36.4
C. celata	2		9.1	
C. vastifica	2		9.1	
C. mucronata	1		4.5	
Polychaete	6		27.4	
Mollusc	5		22.7	
Sipunculid	3		13.6	
Total	22			

The above Table and Fig. 2B indicate that in assessments, both incidence-wise and area-wise, sponges dominate among the various groups of boring organisms.

Species-wise analysis of sponges indicates that *C. ensifera* outnumber others in total incidence in the stalk portion followed by *C. celata*. In terms of total area excavated by each species it may be seen that *C. ensifera* ranks first at this portion. The data obtained on total incidence for the entire island Kavaratti (Fig. 1) show that *C. celata* is the dominant one followed by *C. vastifica*. While comparing the incidence and excavating capacity of the various species of boring sponges n both branches and the stalk portion of a branching coral (here *Acropora* sp.) it becomes evident that *C. ensifera* and *C. celata* are in severe competition for space and in this competition *C. celata* has succeeded in colonising the interior of branches while *C. ensifera*, nside the stalk portion.

B. *Massive coral*

A massive coral collected from Kavaratti (C_3) having an average diameter of 7 cm has been studied in detail for the various organisms that cause damage to hem in the island. The various boring species/groups nd their percentage of incidence are given in Table 4.

Table 4. *Incidence indices of various boring organisms on a massive coral*

Species/groups	Number	% of incidence
Sponge		
C. celata	3	33.3
Polychaete	2	22.2
Mollusc	1	11.1
Crustacea	1	11.1
Sipunculid	1	11.1
Alga	1	11.1
Total	9	

The above Table indicates that sponge forms a major group among the various groups that cause damage to massive corals in Lakshadweep and is followed by polychaete. Incidence-wise all the other groups of boring organisms represented here are of no significance. It could also be noted from Fig. 3 G that *C. celata* is responsible for the breakdown of a sizable part of the massive coral presently investigated, and the larva prefer the under surface of massive coral to settle and grow. Their growth, as seen from Fig. 3 G, is always upwards inside the coral block (negatively geotropic) and in this respect it is quite similar to that noted inside the coral branch (Fig. 2 A).

Conclusion

Damage caused to corals by boring sponges is rather wide spread in all the morphozones of the reefs investigated. In many cases it could even be noted that sponge infection may kill the colony either partly or fully. Any localised death of a colony may not produce far reaching results unless considerable damage occurs to the stalk portion. In a branching colony, that too when it occupies the reef front zone, a partially dead and disintegrated stalk can result in the sliding away of the entire colony into deeper areas where it will be buried by sediments. Branching colonies that occupy level bottom will never experience such a fate since the interlocking of the branches of adjacent colonies will keep them in position even after the total disintegration of the stalk. And in such cases colonies which do not have such interlocking, the tilting to one side will produce a result comparable to that seen in colonies growing along the reef front zone. Goreau and Hartman (*Am. Ass. Advmt. Sci. Publ.*, **75**: 25-54, 1963), who made extensive survey of the reefs off Jamaica, came to the conclusion that too much accumulation of fouling

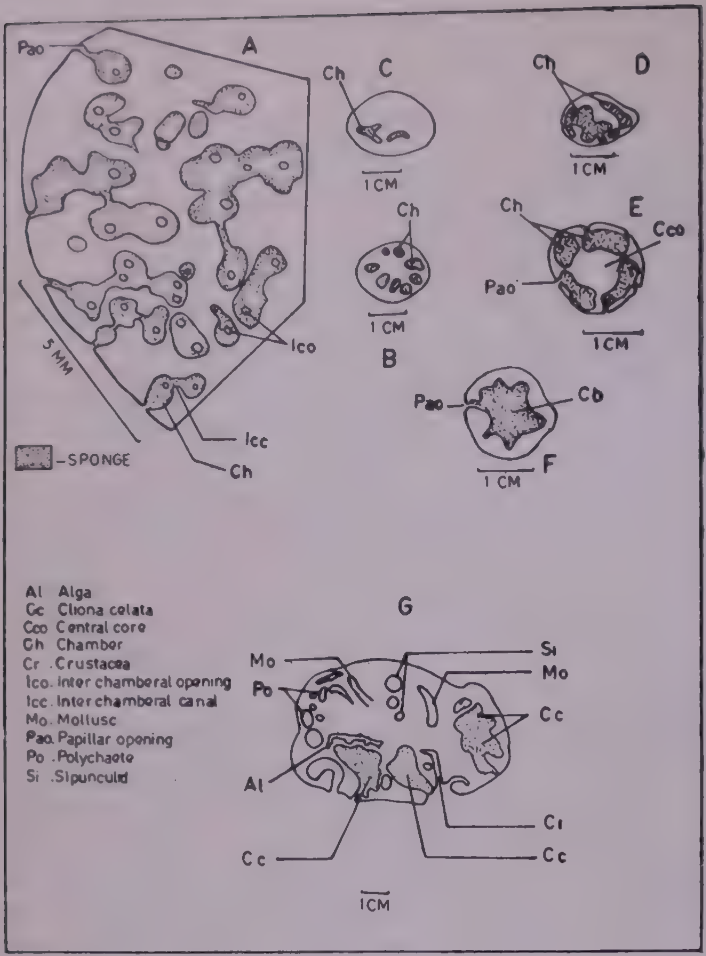

Fig. 3.

A. Cross section of a coral branch (in part) to show the nature of chambers formed inside after the penetration of larva *(C. celata)*. At this point the chambers formed inside (Ch) are more compact and fill the interior almost completely. Icc-Inter chamberal canals, Ico-Inter chamberal openings, Pao-Papillar opening.

B. Cross section of a coral branch infected with *C. celata*. Eight branches are seen originating from the mass of chambers marked in A.

C. Cross section of a coral branch with two branches (of sponge) originating from the mass of chambers marked in A.

D. Cross section of a coral branch. Canals enclosing the branches of sponge are getting widened and partly fused.

E. Cross section of a coral branch. Canals enclosing boring sponge is getting widened due to increased boring activity. These canals, at a later stage, fill the peripheral part of the coral (Ch) leaving a central core of calcareous material (Cco). These canals communicate with the exterior through papillar-openings (Pao).

F. Cross section of a coral branch. The central core of calcareous material (Cco) is completely destroyed resulting in a wide central cavity filled with sponge.

G. Section of a massive coral collected from morphozone C_3 of Kavaratti Island. Diagramatic representation of the coral showing the various species/grounds of boring organisms and their distribution.

organisms may cause considerable strain on the coral colony in which the stalk has already been weakened by borers. But they have suggested that such situation often turn out to be a blessing for corals because massive sponges that grow across adjacent colonies will help to keep any coral colony, which is in distress, in position. In the case of massive corals the question of getting themselves dislodged in such a manner, is quite remote. In such cases partial death is only possible and at Kavaratti lagoon it is seen that boring algae flourish in the upper, well lighted side of massive corals killing the polyps totally. But the coral colony compensates for the situation by accelerating its growth along the periphery producing a circular rim around the zone of dead polyps. In some cases it could even be noted that this overgrowing outer rim may curl in and completely cover the central area of dead polyps. If this is not possible it is seen that sedentary organisms attach themselves and grow in this area of dead polyps. *Tridacna* sp. may be seen attached to this area generally.

Goreau and Hartman (1963 *op. cit.*) concluded that mass transport of loosened corals and coarse detritus from the upper reef to the deep fore-reef slope is due to (a) talus fall, (b) slides and avalanches and (c) reef subsidence and slump. The fore-reef slope which is often covered with soft sediments becomes more stable and well drained when coarse coral bits get deposited over it. This situation will indirectly encourage the colonisation of corals. The minute calcium carbonate particles etched out from coral by the activity of boring sponges constitute a major ingredient of the sediment fraction in any reef system. These particles have important lubricating and fluidizing properties which speed up the drainage of skeletal sediments from the reef.

INTRODUCTION OF 43 FOOTER MECHANISED BOATS FOR COMMERCIAL TRAWLING ALONG THE COAST OF ANDHRA PRADESH*

Along the coast of Andhra Pradesh commercial fishery started in 1964 with small mechanised boats ('pablos') and subsequently in a short period of three years two more types of boats ('Royya' and 'Sorrah') were introduced. Since then, these three types of boats were engaged in fishing in the region without any modification. Among these three types, the 'Royya' category is most dominant in the fleet. Recently, in January, 1988 another type of 43 footer boat popularly known as 'Sona' (Fig. 1) was added to the existing fleet. Out of fifty boats constructed at Kakinada by private boat builders, 30 boats are registered at Visakhapatnam and they have been conducting fishing there. On enquiry with boat-owners and boat-builders, it is understood that these boats are introduced to conduct fishing for about 15 days. Use of 43 footer vessel for commercial fishing is new to the northeast coast. Therefore the details of boat and the catch obtained are given in this note. The particulars of the boat and engine are shown in Table 1 and those of the nets used along with those already in use by existing boats are shown in Table 2. The catches of those boats already fishing in this region are compared with those of 'Sona' boats (Table 3).

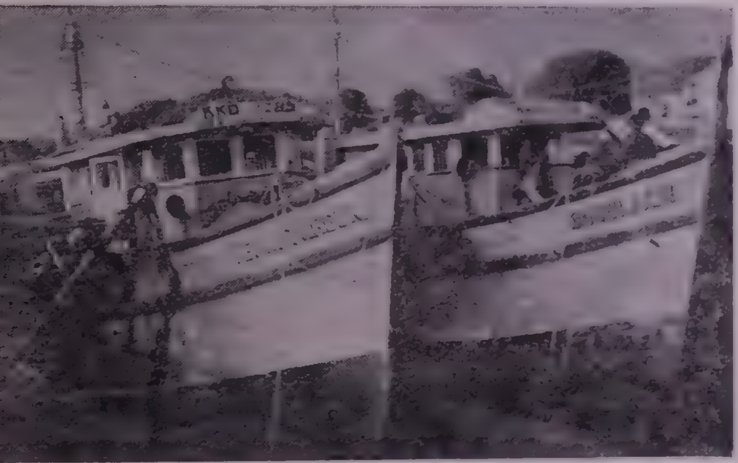

Fig. 1. A view of two 'sona' boats moored at the Kakinada Fisheries Harbour.

The introduction of costly bigger boats in the commercial fleet at a time when most of the resources in the presently fished areas have reached MSY levels appears significant. The introduction of these boats is primarily to go for fishing for a period of 10–15 days without returning to the base daily thereby cutting expenditure on oil. The information on depth of operation and the catches obtained during January – March period shows that unlike the smaller boats these boats

Table 1. *Specifications of 43 footer boats newly introduced along AP coast*

1. Name of the boat	'SONA'
2. Place of construction	KAKINADA
3. Dimensions of the boat	
a) Length	13.1 m
b) Beam	4.1 m
c) Draught	2.8 m
d) Depth	2.0 m
e) Speed	9 km
f) Endurance	15 days
4. Tonnage of vessel	
a) Gross tonnage	18
b) Net tonnage	5.5
5. Materials	
a) Type of material	Teak wood
b) Quantity of material required	800 cubic feet
c) Cost of the material	Rs. 220/- per cubic foot
6. Type of construction	Carvel
7. Type of protection for under water surface of hull	Fibre glass & aluminium sheeting
8. a) Type of engine	Ashok Leyland
b) Horse power	102
9. No. of persons can be accomodated	9
10. Winches	1 mechanical winch with GI wire rope
11. Capacities	
a) Fish hold	Nil (6 fibre-glass tanks with ice)
b) Fresh water capacity	2,000 litres (F. tanks)
c) Fuel capacity	5,000 litres
12. Cost of the boat	Rs. 8 lakhs
13. Navigational aid	Compass
14. Communication system	Nil
15. Life of the boat	15–20 years (approximately)

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* Prepared by K. Chittibabu, P. Ramalingam, K. Dhanaraju, and T. Nageswara Rao, Kakinada Research Centre of CMFRI, Kakinada.

are fishing in relatively deeper areas (Table 3). The catches and catch rates, however, do not seem to be better than those obtained by the boats already existing. However, collection of data on the effort, catch, species composition from these newly introduced boats together with information on economics of operation for at least a period of 1-2 years can only help to understand the economic viability of these boats in the present context of shrimp oriented trawling. Since it is known that certain important fin-fishes like thread-fin breams are abundant in relatively deeper waters of 75–100 m depth, deployment of bigger boats to fish in these areas appears reasonable. This will help in exploiting the under-exploited areas while allowing the smaller boats to continue to fish in the presently fished areas. Further, almost the entire mechanised fishing industry along Andhra coast is concentrating only in bottom trawling. It is believed that a beginning can be made for mechanised gill netting in deeper areas and purse-seining particularly in view of the increasing demand for quality fish.

Table 2. *Details of craft and gear used at Kakinada*

Particulars of the vessel					Particulars of the gear operated					
Type of Boat	Length (m)	Beam (m)	Draught (m)	Engine (H.P.)	Type of net	Length of head rope (m)	Mesh size (cm)	Otter boards	Rigging	Net operation
Pablo	9.14	2.49	0.87–0.97	40–45	4-beam trawl made of synthetic mono-filament of 0.5–1.0 mm diameter	11.89 & 12.95	Wings: 6–7.5 Body: 3.8–4.5 Cod end: 1.5–2.0	Rectangular 35 kgs	Double expanded legs upto a length of 5–10 m	Mechanical winch with G.I. wire rope
Royya	9.75 & 10.0	2.9	1.07	45–60	–do–	14.94, 16.5 and 18.29	–do–	40–45 kgs	–do– upto a length of 15–20 m	–do–
Sorrah	11.4	3.2	1.25	60–80	–do–	–do–	–do–	45–60 kgs	–do– upto a length of 10–20 m	–do–
Sona	13.1	4.1	2.8	100–120	–do–	20–22	Wings: 6–7.5 Body: 3.8–5.2 Cod end: 2.5–3.0	60–80 kgs	–do– upto a length of 15–25 m	–do–

Table 3. *Fishing details of various types of boats*

Type of Boat	Number of boats operated	Trawling hours	Av. depth of operation (m)	Average catch per boat (kg)	Catch per hour (kg)	Average catch of shrimp per boat (kg)	Catch of shrimps per hour (kg)
January, 1988							
Sona	4	200	45	3,621	72.4	789	15.8
Sorrah	228	3,632	25	717	45.0	166	10.4
Royya	2,144	29,164	20	550	40.4	127	9.3
Pablo	204	2,056	20	269	26.7	72	7.2
February, 1988							
Sona	36	2,439	42	1,972	29.1	399	5.9
Sorrah	234	3,108	25	593	45.0	121	9.1
Royya	1,704	18,514	20	325	30.0	98	9.1
Pablo	152	914	15	150	25.0	65	10.8
March, 1988							
Sona	47	1,527	45	1,471	45.3	271	8.4
Sorrah	229	2,651	25	430	37.1	72	6.3
Royya	1,988	18,433	20	365	39.3	62	6.7
Pablo	236	1,418	10	167	27.8	35	5.8
Average for three months							
Sona	29	1,389	44	1,777	37.1	348	7.26
Sorrah	230	3,130	25	580	42.7	120	8.8
Royya	1,945	22,037	20	421	37.2	97	8.5
Pablo	197	1,463	15	198	26.7	56	7.5

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Technical and Extension Series

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
COCHIN, INDIA

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THE MARINE FISHERIES INFORMATION SERVICE: Technical and Extension Series envisages the rapid dissemination of information on marine and brackish water fishery resources and allied data available with the National Marine Living Resources Data Centre (NMLRDC) and the Research Divisions of the Institute, results of proven researches for transfer of technology to the fish farmers and industry and of other relevant information needed for Research and Development efforts in the marine fisheries sector.

Abbreviation – *Mar. Fish. Infor. Serv., T & E Ser.,* No. **87**: 1988

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3. Successful induced spawning and rearing of the holothurian *Holothuria (Metriatyla) scabra* Jaeger at Tuticorin

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Front cover photo:

Ribbon fish *(Trichiurus* sp.*)* – a common fish resource of Vizhinjam.

Back cover photo:

A busy fish landing centre at Vizhinjam.

MARINE FISH CALENDAR

IX. VIZHINJAM*

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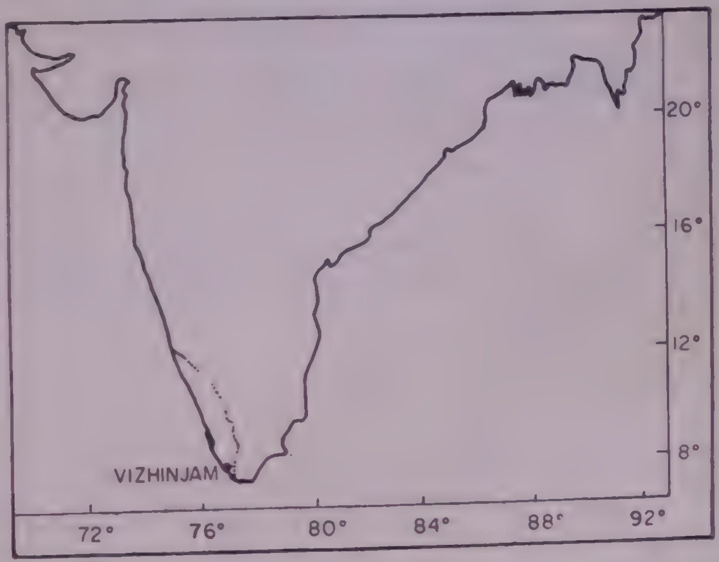
Introduction

The fishery investigations in various parts of India have established that there are divergence in the pattern of species distribution and their abundance in these regions. Such changes are also noticed annually at a particular region as well as between closely adjacent centres of the same region. Therefore certain trends and patterns in seasons and abundance of the major fisheries become apparent from prolonged observations. Data collected over a period of five years, from 1981 to 1985, from the landing centre at Vizhinjam have been analysed to draw up a general fishery calendar suitable for this centre elucidating the cyclic changes in the abundance and dominance of the commercially important species/ groups of fish within a year.

Vizhinjam, 16 km, south of Trivandrum in Kerala State (Lat. 8°22' 30" N, Long. 76° 59' 15" E), is an important fish landing centre in the fishery zone extending from Kollangode in the south to Valiaveli in the north spreading over a distance of 50 km on the southwest coast of India. Owing to the bay protected by breakwaters, which affords facilities for launching the boats into the sea even in the peak monsoon, fishing activity takes place in Vizhinjam area all through the year. Moreover the Vizhinjam Fishing Harbour, which is underway provides facilities for safe launching and harbouring of the crafts as well as landing of the catch. Good marketing outlets are available at nearby places such as Trivandrum, Balaramapuram and adjacent towns. The fishery is artisanal, employing catamaran, dugout canoe, plankbuilt boat and indigenous gears such as boat seine ('Thattumadi'), drift net ('Pattu vala'), hooks and line ('Choonda') *etc.* Neither trawling nor purse seining is being carried out at this centre. Mechanisation came very late to Vizhinjam, while in the nearby places like Sakthikulangara and Kolachal mechanised fishing had been well established even years back. Vizhinjam fishermen were rather cautiously avoiding mechanised fishing since they feared that favouring mechanisation may invite big businessmen into the field which may adversely affect the traditional fishing sector. However, in 1981 a few small mechanised boats have started operating in this area using traditional drift nets. But only a few fishermen could afford to the high capital investment and operational costs. By about September, 1982, five traditional crafts fitted with outboard motors started operating from Vizhinjam. Due to the high profit obtained by the fishermen and low capital and operational costs for the outboard motor when compared to those of mechanised boats, the mechanisation of traditional crafts with outboard motor became acceptable to the fishermen. In the course of past five years the total number of outboard motors at this centre increased to about 400. This trend is bound to continue, in view of the prospect of the fishing harbour under construction.

Mechanised craft generally go about 20–25 km off Vizhinjam to area of 60–80 m depth, whereas the



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* Consolidated by N. Gopinatha Menon and K. Balachandran, CMFRI, Cochin.

non-mechanised crafts are confined to about 10 km from the shore and a depth range of 40–50 m. The number of actual fishing days in a month ranged from 20 to 25 for both the types of units.

The data collected from 1981 to 1985 have been processed for the preparation of the calendar. The data show that the annual marine fish landings (fin fish alone) at Vizhinjam ranged from 5,207.01 t in 1981 to 9,726.2 t in 1985 with the annual average landings at 6,374.41 t. The average monthly landings varied from 147.88 t in January to 1,230.05 t in July with the overall monthly average at 531.2 t. Fish landings higher than this monthly average were obtained during June to October, when nearly 71.3% of the annual catch was landed. It may be seen that the fishing effort was fairly high from May to October and there was also a corresponding increase in the catch and catch rate in these months. The highest catch (1,230.05 t) and catch rate (67.22 kg) were observed during July. From the foregoing trend it may be stated that June to October presents the main fishing season with best return in July in the Vizhinjam area. A large variety of fishes support the fishery at Vizhinjam and the landings of each gear have a characteristic species composition.

At present ten types of traditional gears are employed in Vizhinjam area to exploit its fishery resources. Of these boat seine, hooks and line, 'achil' (a tape of hand line with smaller hooks) and shore seine together contribute to the bulk (74.87%) of the total fish landings and the rest (25.13%) by gill nets which include drift net, 'chala vala', 'netholi vala', 'kolachi vala', 'konchu vala' and 'nandu vala'.

Apart from those species mentioned in this calendar, a number of species of fishes, which formed stray catches showing no regular fishery and were quite insignificant as independent fishery, also contributed to the fishery.

In addition to these, the juveniles of almost all major commercially important fishes formed a minor fishery locally called 'Nonna' fishery. This contributed to 0.03%. The fishery season extended from October to August. The average annual catch was 2.134 t with monthly catch ranging from 4 kg in October to 451 kg in August.

AMBASSIDAE

Popular English Name	:	Glassy perchlets
Vernacular Name (Malayalam)	:	'Mulli'
Annual average catch	:	5.7 t
Percentage in total catch	:	0.09
Fishing methods and their contribution	:	Boat seine : 0.08% Shore seine : 0.01%

ATHERINIDAE

Popular English Name	:	Hardy heads
Vernacular Name (Malayalam)	:	'Therani'
Annual average catch	:	2.8 t
Percentage in total catch	:	0.04
Fishing methods and their contribution	:	Boat seine: — Shore seine: —

BALISTIDAE

Popular English Name	:	File fish
Vernacular Name (Malayalam)	:	'Clathi'
Annual average catch	:	43.1 t
Percentage in total catch	:	0.67
Fishing methods and their contribution	:	Hooks & line: 0.67%

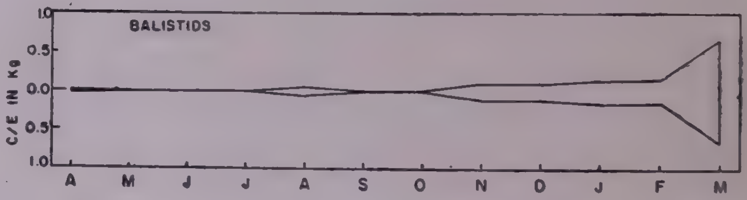

Fig. 1. Seasonal abundance of balistids at Vizhinjam.

BELONIDAE

Popular English Name	:	Needle fish/ Gar fishes
Vernacular Name (Malayalam)	:	'Kozhiyan mural'
Annual average catch	:	19.8 t
Percentage in total catch	:	0.31
Fishing methods and their contribution	:	Hooks & line: 0.17% Drift net : 0.14%

CARANGIDAE

Popular English Name	:	Trevallies/Horse mackerel/ Queenfish/Darts
Vernacular Name (Malayalam)	:	'Para'
Annual average catch	:	986.0 t
Percentage in total catch	:	15.47

Fishing methods and their contribution : Drift net: 2.49%
Chala vala: 0.19%
Konchu vala: 0.37%
Hooks & line: 9.92%
Boat seine: 2.40%
Shore seine: 0.11%

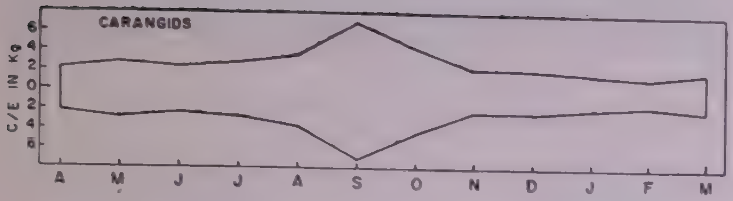

Fig. 2. Seasonal abundance of carangids at Vizhinjam.

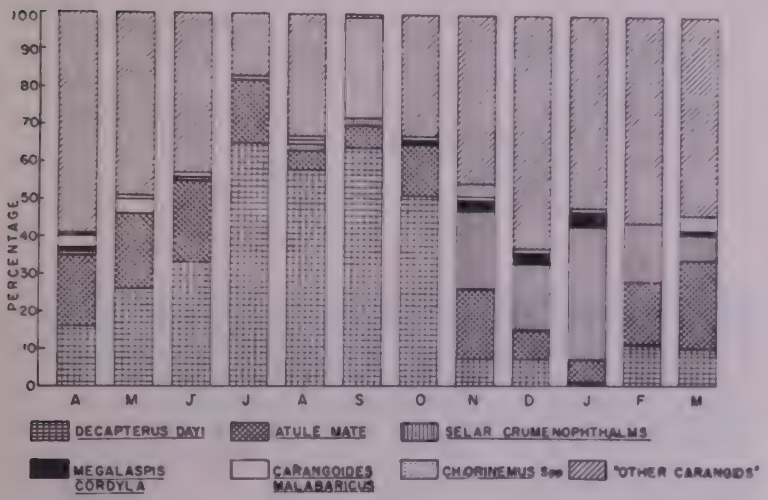

Fig. 3. Monthwise species composition of carangids in indigenous gears.

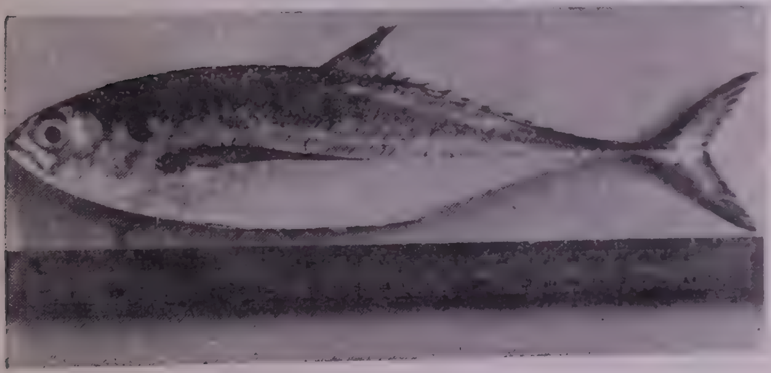

Fig. 4. *Megalaspis cordyla.*

Scientific Name : *Megalaspis cordyla*
Vernacular Name : 'Vankada'
Gear : Drift net/Hooks & line/Shore seine/Boat seine
Peak period of occurrence : Oct. – Jan.
Depth of occurrence : 40 – 60 m
Length range in commercial fishery : 130 – 374 mm
Size at first maturity : —
Spawning season : Nov. – Dec.

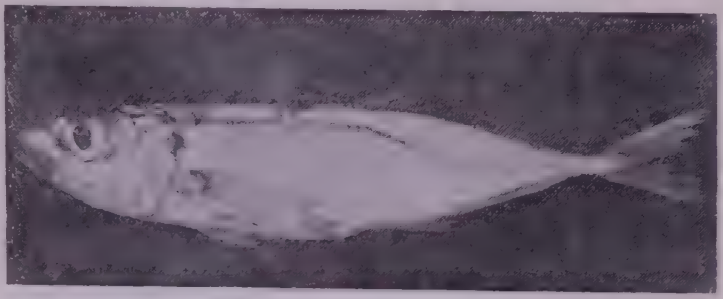

Fig. 5. *Decapterus dayi*

Scientific Name : *Decapterus dayi*
Vernacular Name : 'Kozhiyala'
Gear : Hooks & line/Chala vala/Boat seine/Shore seine/Konchu vala
Peak period of occurrence : May – Oct.
Depth of occurrence : 15 – 60 m
Length range in commercial fishery : 60 – 229 mm
Size at first maturity : 130 mm
Spawning season : Mar. – May and Aug.–Oct.

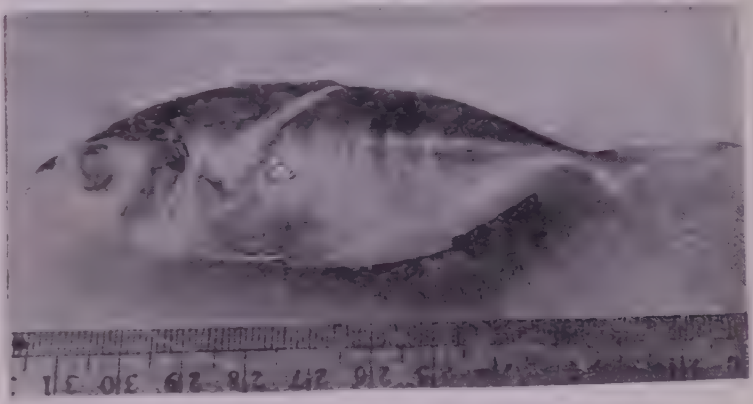

Fig. 6. *Atule mate.*

Scientific Name : *Atule mate*
Vernacular Name : 'Urula para'
Gear : Drift net/Chala vala/Konchu vala/Hooks & line/Boat seine/Shore seine
Peak period of occurrence : Mar. – July and Sep. – Nov.

Depth of occurrence : 30 – 60 m
Length range in commercial fishery : 100 – 314 mm
Size at first maturity : —
Spawning season : Apr. - Jul.

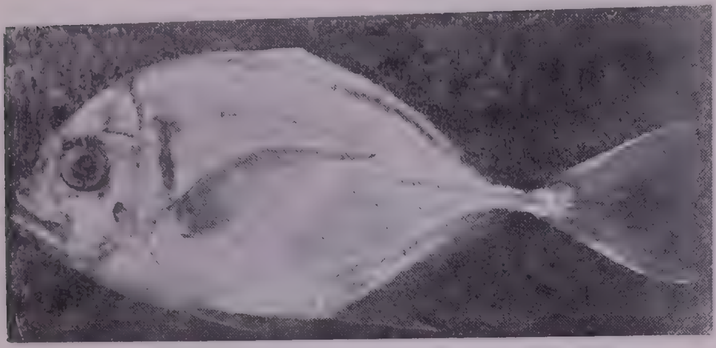

Fig. 7. *Carangoides malabaricus.*

Scientific Name : *Carangoides malabaricus*
Vernacular Name : 'Vattakkanni para'
Gear : Hooks & line/ Drift net/ Konchu vala
Peak period of occurrence : Apr. – May and Oct.
Depth of occurrence : 30 – 60 m
Length range in commercial fishery : 110 – 215 mm
Size at first maturity : —
Spawning season : —

CHIROCENTRIDAE

Popular English Name : Wolf - herrings
Vernacular Name (Malayalam) : 'Mulluvaala'
Annual average catch : 22.2 t
Percentage in total catch : 0.35
Fishing methods and their contribution : Drift net: 0.18 %
Hooks & line: 0.04 %
Chala vala: 0.10 %
Konchu vala: 0.03 %

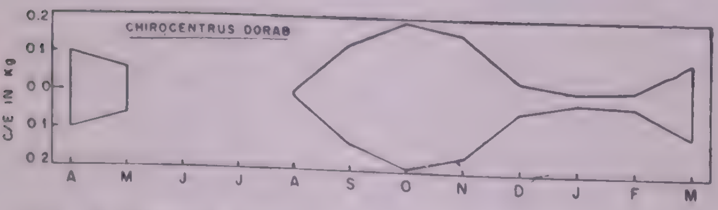

Fig. 8. Seasonal abundance of chirocentrids at Vizhinjam.

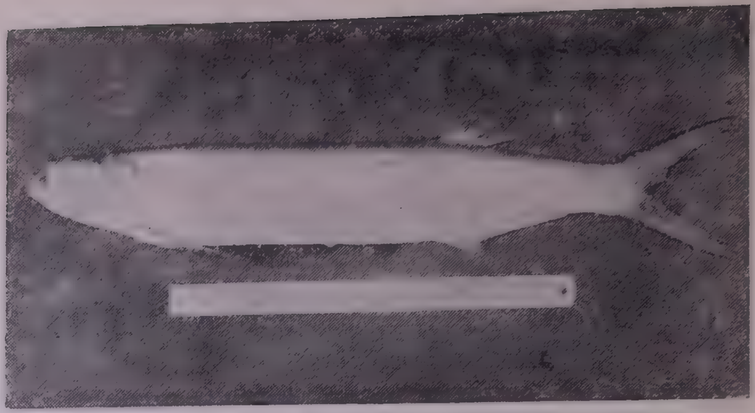

Fig. 9. *Chirocentrus dorab.*

Scientific Name : *Chirocentrus dorab*
Vernacular Name : 'Mulluvaala'
Gear : Gill net
Peak period of occurrence : Aug. – May and Sep. – Nov.
Depth of occurrence : 30 – 60 m
Length range in commercial fishery : —
Size at first maturity : —
Spawning season : —

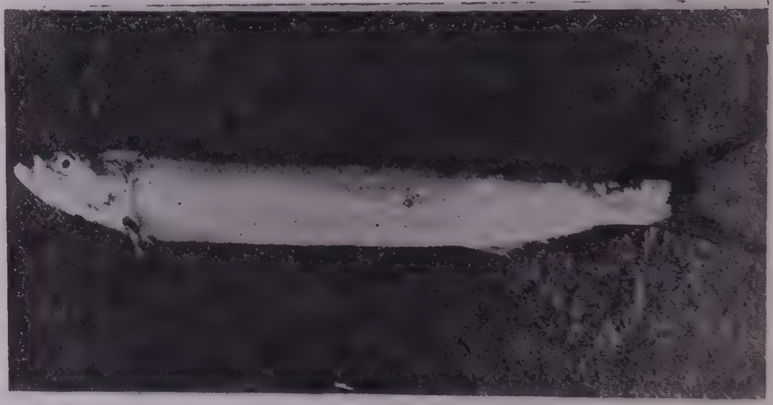

Fig. 10. *Chirocentrus nudus.*

Scientific Name : *Chirocentrus nudus*
Vernacular Name : 'Mulluvaala'
Gear : Gill net
Peak period of occurrence : Aug. – May and Sep. – Nov.
Depth of occurrence : 30 – 60 m
Length range in commercial fishery : —
Size at first maturity : —
Spawning season : —

CLUPEIDAE

Popular English Name : Sardines
Vernacular Name (Malayalam) : 'Chala'

Annual average catch	:	312.01 t
Percentage in total catch	:	4.89
Fishing methods and their contribution	:	Chala vala: 4.14% Shore seine: 0.15% Hooks & line: 0.07% Boat seine: 0.53%

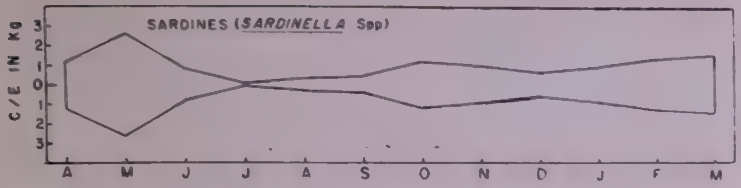

Fig. 11. Seasonal abundance of sardines at Vizhinjam.

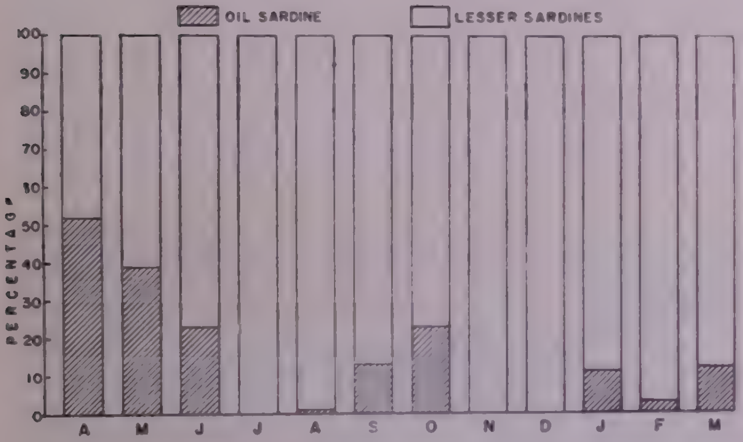

Fig. 12. Monthwise species composition of clupeids in indigenous gears at Vizhinjam.

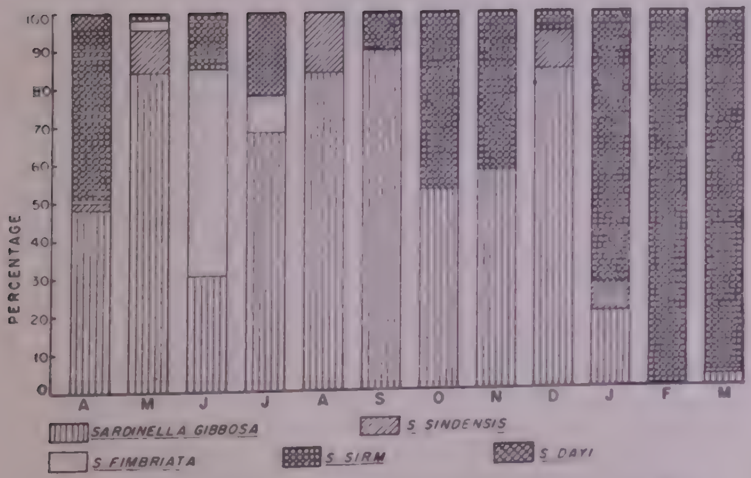

Fig. 13. Monthwise species composition of lesser sardines in indigenous gears at Vizhinjam.

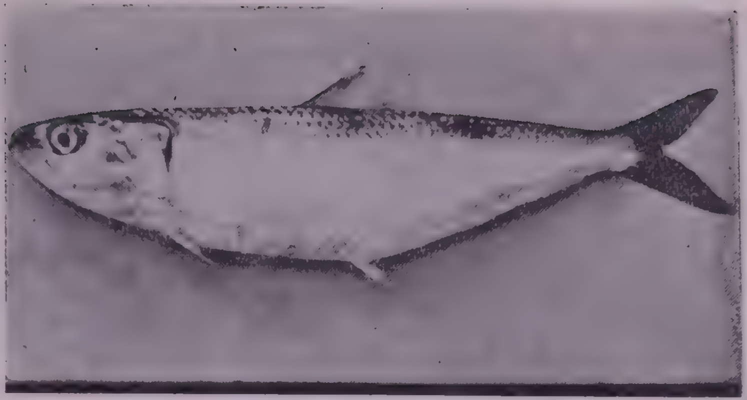

Fig. 14. *Sardinella longiceps.*

Scientific Name	:	*Sardinella longiceps*
Vernacular Name	:	'Nei-chala'
Gear	:	Chalavala/Shore seine/Hooks & line
Peak period of occurrence	:	Mar.–Jun.
Depth of occurrence	:	Up to 40 m
Length range in commercial fishery	:	88 - 224 mm
Size at first maturity	:	—
Spawning season	:	Apr. – May and Sep. – Oct.

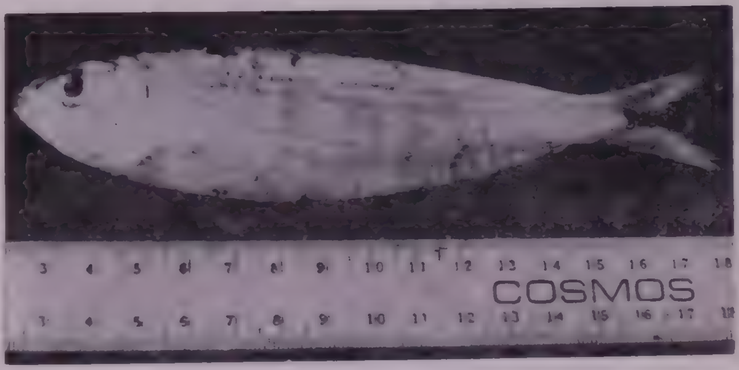

Fig. 15. *Sardinella gibbosa.*

Scientific Name	:	*Sardinella gibbosa*
Vernacular Name	:	'Chala'
Gear	:	Chala vala/Shore seine, Hooks & line
Peak period of occurrence	:	Jan. – Jun.
Depth of occurrence	:	Upto 20 m
Length range in commercial fishery	:	84 – 194 mm
Size at first maturity	:	—
Spawning season	:	Apr. – Aug.

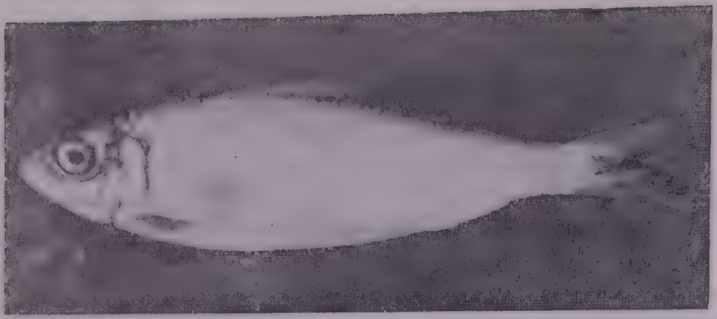

Fig. 16. *Sardinella fimbriata.*

Scientific Name : *Sardinella fimbriata*
Vernacular Name : 'Karichala'
Gear : Chala vala
Peak period of occurrence : Apr. – Jul.
Depth of occurrence : Upto 30 m
Length range in commercial fishery : 120 – 189 mm
Size at first maturity : —
Spawning season : —

CORYPHAENIDAE

Popular English Name : Dolphin fish
Vernacular Name (Malayalam) : 'Palameen'
Annual average catch : 24.6 t
Percentage in total catch : 0.39
Fishing methods and their contribution : Hooks & line: 0.37 %
Drift net: 0.02 %

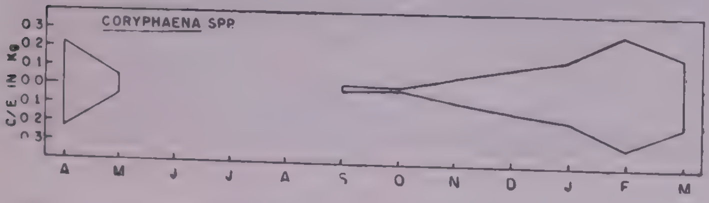

Fig. 17. Seasonal abundance of dolphin fish at Vizhinjam.

CYNOGLOSSIDAE

Popular English Name : Soles/Flat fishes
Vernacular Name (Malayalam) : 'Nilampathungi'/ 'Erumanakku'
Annual average catch : 5.5 t
Percentage in total catch : 0.09
Fishing methods and their contribution : Boat seine : 0.08 %
Konchu vala: 0.01 %

DUSSUMIERIDAE

Popular English Name : Rainbow sardine
Vernacular Name (Malayalam) : 'Mopal'/ 'Muthupolappan'/ 'Kokkola'
Annual average catch : 149.0 t
Percentage in total catch : 2.33
Fishing methods and their contribution : Chala vala: 0.13 %
Boat seine: 1.05 %
Shore seine: 0.02 %
Hooks & line: 1.13 %
Konchu vala: 0.01 %

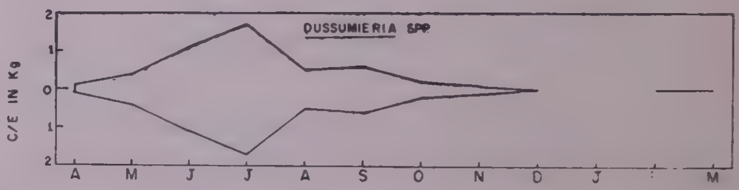

Fig. 18. Seasonal abundance of rainbow sardines at Vizhinjam.

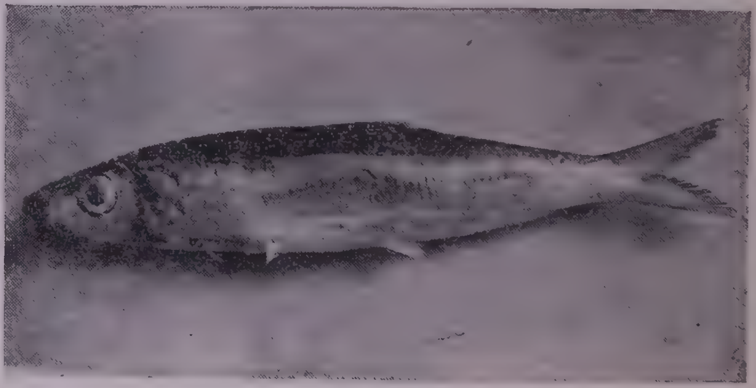

Fig. 19. *Dussumieria hasseltii.*

Scientific Name : *Dussumieria hasseltii*
Vernacular Name : 'Moral'/ 'Muthupolappan' / 'Kokkola'
Gear : Chala vala/Boat seine/Hooks & line
Percentage composition in the gear : —
Peak period of occurrence : May – Sep.
Depth of occurrence : Upto 40 m
Length range in commercial fishery : 80 – 224 mm
Size at first maturity : 170 mm
Spawning season : —

ELASMOBRANCHS

Popular English Name	:	Sharks/Rays/Skates
Vernacular Name (Malayalam)	:	'Sravu'/'Therachi'/ 'Poonthi'
Annual average catch	:	82.9 t
Percentage in total catch	:	1.3
Fishing methods and their contribution	:	Hooks and line: 0.37% Drift net: 0.64% Boat seine: 0.19% Shore seine: 0.01% Konchu vala: 0.09%

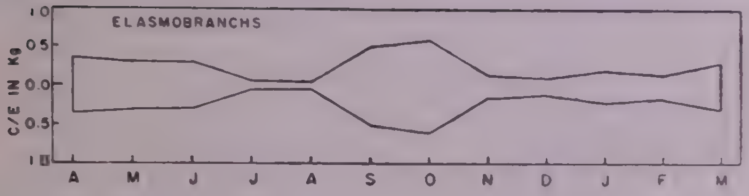

Fig. 20. Seasonal abundance of elasmobranchs at Vizhinjam.

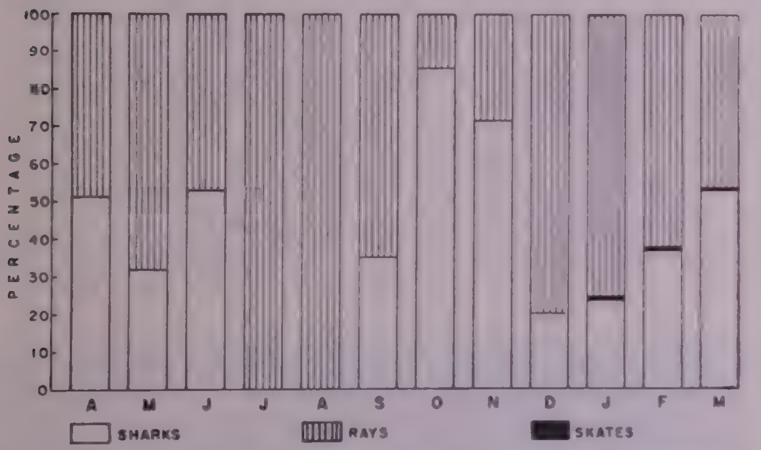

Fig. 21. Monthwise species composition of elasmobranchs at Vizhinjam.

ENGRAULIDAE

Popular English Name	:	Anchovy
Vernacular Name (Malayalam)	:	'Netholi'
Annual average catch	:	727.3 t
Percentage in total catch	:	11.41
Fishing methods and their contribution	:	Netholi vala: 1.18% Boat seine: 10.05% Shore seine: 0.13% Chala vala: 0.03% Konchu vala: 0.02%

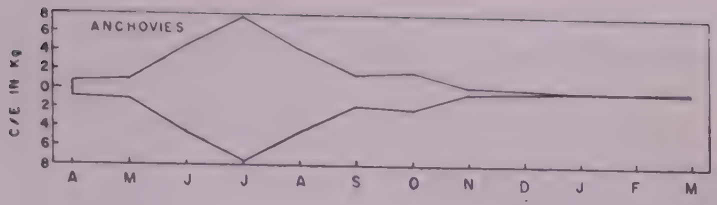

Fig. 22. Seasonal abundance of anchovies at Vizhinjam.

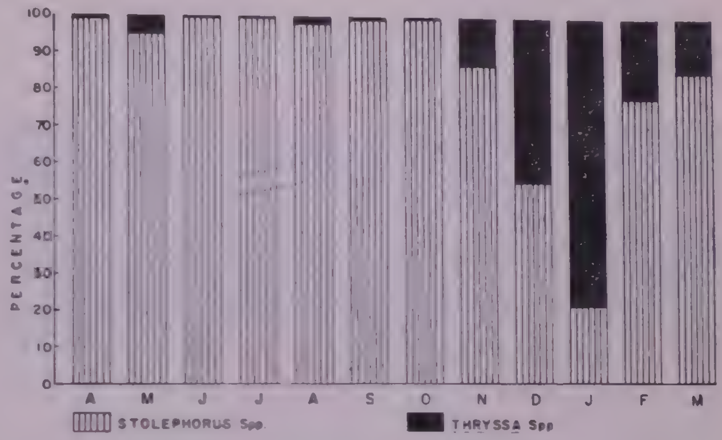

Fig. 23. Monthwise composition of *Stolephorus* and *Thryssa* in indigenous gears at Vizhinjam.

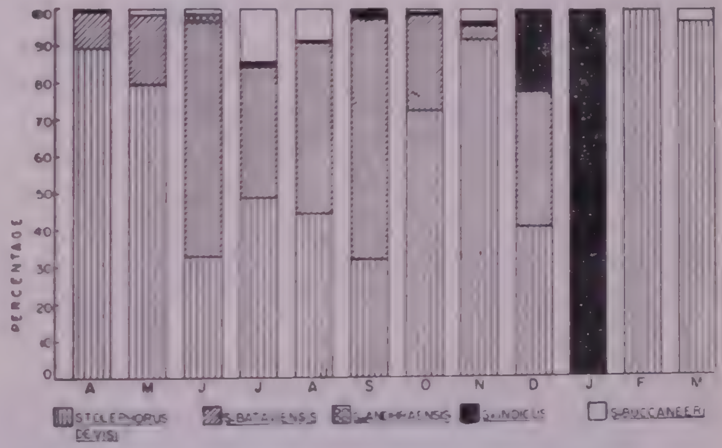

Fig. 24. Monthwise species composition of anchovies in indigenous gears at Vizhinjam.

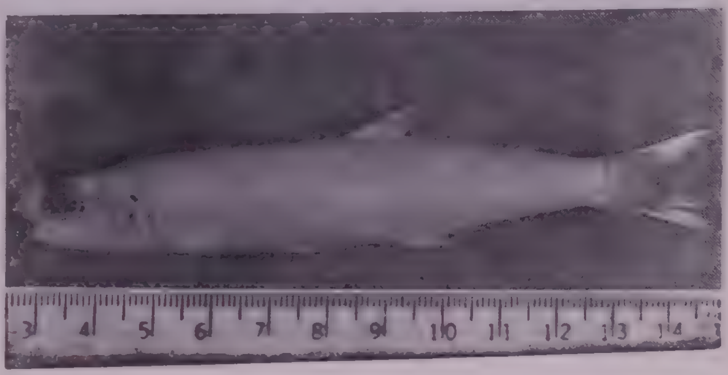

Fig. 25. *Stolephorus indicus.*

Scientific Name : *Stolephorus indicus*
Vernacular Name : 'Netholi'
Gear : Boat seine/Shore seine/Netholi vala (Gill net)
Peak period of occurrence : Aug. – Oct.
Depth of occurrence : 5 - 15 m
Length range in commercial fishery : 70 – 149 mm
Size at first maturity : 120 mm
Spawning season : Oct. – Jun.

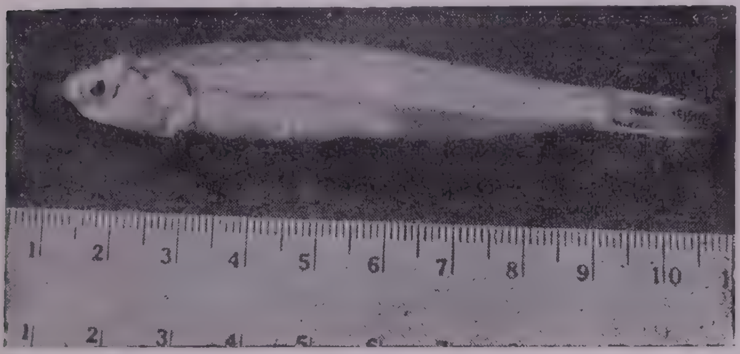

Fig. 26. *Stolephorus devisi.*

Scientific Name : *Stolephorus devisi*
Vernacular Name : 'Netholi'
Gear : Netholi vala/Boat seine/Shore seine
Peak period of occurrence : Apr. – Nov.
Depth of occurrence : 5 – 15 m
Length range in commercial fishery : 30 - 140 mm
Size at first maturity : 60 mm
Spawning season : Extended spawner

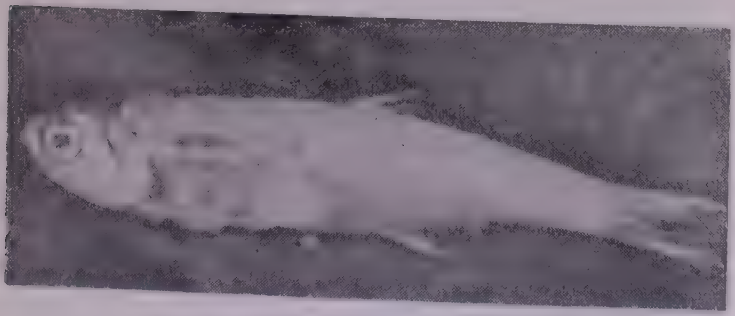

Fig. 27. *Stolephorus bataviensis.*

Scientific Name : *Stolephorus bataviensis*
Vernacular Name : 'Manja netholi'
Gear : Netholi vala/Boat seine/Shore seine
Peak period of occurrence : May – Oct.
Depth of occurrence : Upto 15 m
Length range in commercial fishery : 45 – 109 mm
Size at first maturity : 75 mm
Spawning season : Extended spawner

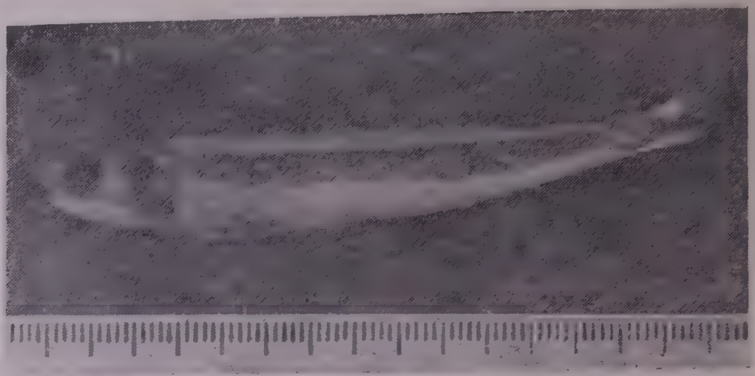

Fig. 28. *Stolephorus buccaneeri.*

Scientific Name : *Stolephorus buccaneeri*
Vernacular Name : 'Karu netholi'
Gear : Netholi vala/Boat seine/Shore seine
Peak period of occurrence : Jul. –Aug.
Depth of occurrence : 5 – 15 m
Length range in commercial fishery : 30 – 99 mm
Size at first maturity : 45 mm
Spawning season : Oct. -Jun.

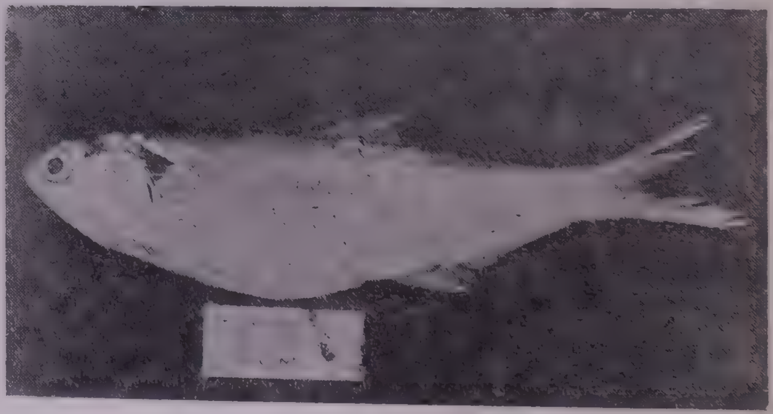

Fig. 29. *Thryssa mystax.*

Scientific Name : *Thryssa mystax*
Vernacular Name : 'Kootal'
Gear : Shore seine/Boat seine/Konchu vala/Chala vala
Peak period of occurrence : —
Depth of occurrence : —

Length range in commercial fishery : —
Size at first maturity : —
Spawning season : —

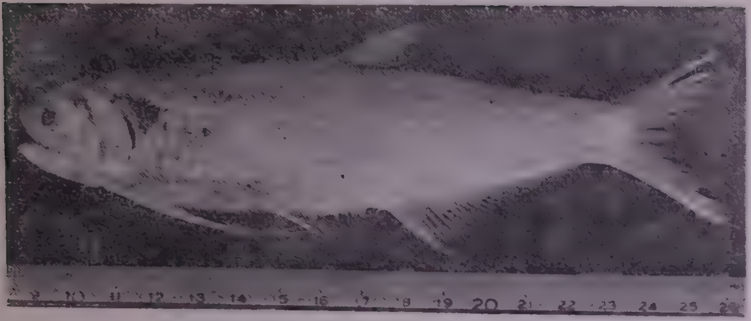

Fig. 30. *Thryssa setirostris.*

Scientific Name : *Thryssa setirostris*
Vernacular Name : 'Kootal'
Gear : Shore seine/Boat seine/Konchu vala/Chala vala
Peak period of occurrence : May, Aug. and Dec.
Depth of occurrence : Upto 30 m
Length range in commercial fishery : 85 – 170 mm
Size at first maturity : —
Spawning season : Nov.-Dec.

HEMIRAMPHIDAE

Popular English Name : Half – beak
Vernacular Name (Malayalam) : 'Kolachi'/ 'Ottachundan kola'
Annual average catch : 2.6 t
Percentage in total catch : 0.04
Fishing methods and and their contribution : Kolachi vala: 0.04 %

HOLOCENTRIDAE

Popular English Name : Squirrel fish
Vernacular Name (Malayalam) : 'Katantha mulli'
Annual average catch : 0.3 t
Percentage in total catch : —
Fishing methods and their contribution : Hooks & line/ Drift net: —

ISTIOPHORIDAE

Popular English Name : Sail-fish
Vernacular Name (Malayalam) : 'Thala'
Annual average catch : 30.9 t
Percentage in total catch : 0.48
Fishing methods and their contribution : Hooks & line: 0.42 %
Drift net: 0.06 %

LACTARIDAE

Popular English Name : White fish
Vernacular Name (Malayalam) : 'Parava'
Annual average catch : 12.6 t
Percentage in total catch : 0.20
Fishing methods and their contribution : Boat seine: 0.17 %
Konchu vala: 0.03 %

LEIOGNATHIDAE

Popular English Name : Silver bellies
Vernacular Name (Malayalam) : 'Karal'
Annual average catch : 167.7 t
Percentage in total catch : 3.95
Fishing methods and their contribution : Boat seine: 3.39 %
Shore seine: 0.12 %
Chala vala: 0.37 %
Konchu vala: 0.07 %

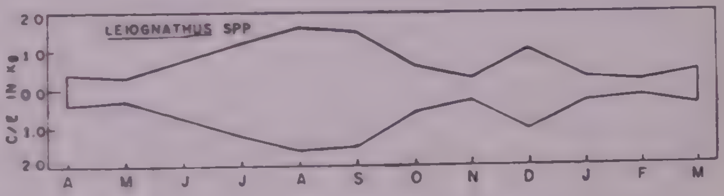

Fig. 31. Seasonal abundance of silver bellies at Vizhinjam.

LETHRINIDAE

Popular English Name : Pigface-breams/ Emperor-breams
Vernacular Name (Malayalam) : 'Velameen'
Annual average catch : 37.8 t
Percentage in total catch : 0.59
Fishing methods and their contribution : Hooks & line: 0.34 %
Drift net: 0.21 %
Boat seine: 0.03 %

LUTJANIDAE

Popular English Name : Snapper job fishes
Vernacular Name (Malayalam) : 'Chempalli'
Annual average catch : 33.2 t
Percentage in total catch : 0.52
Fishing methods and their contribution : Hooks & line: 0.31%
Drift net: 0.14%
Konchu vala: 0.04%
Boat seine: 0.02%

MENIDAE

Popular English Name : Moon fishes
Vernacular Name (Malayalam) : 'Kannadi karal'
Annual average catch : 1.9 t
Percentage in total catch : 0.03
Fishing methods and their contribution : Boat seine: 0.03%

MUGILIDAE

Popular English Name : Mullets
Vernacular Name (Malayalam) : 'Mala'/'Kanambu'
Annual average catch : 24.1 t
Percentage in total catch : 0.38
Fishing methods and their contribution : Boat seine: 0.37%

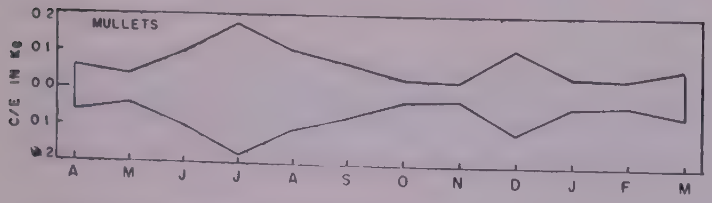

Fig. 32. Seasonal abundance of mullets at Vizhinjam.

MULLIDAE

Popular English Name : Goat fishes
Vernacular Name (Malayalam) : 'Nakara'/'Kilivarnadu'
Annual average catch : 5.5 t
Percentage in total catch : 0.09
Fishing methods and their contribution : Boat seine: 0.05%
Konchu vala: 0.04%

NEMIPTERIDAE

Popular English Name : Threadfin bream
Vernacular Name (Malayalam) : 'Kilimeen'
Annual average catch : 167.7 t
Percentage in total catch : 2.63
Fishing methods and their contribution : Hooks & line: 2.55%
Boat seine: 0.05%
Gill net: 0.04%

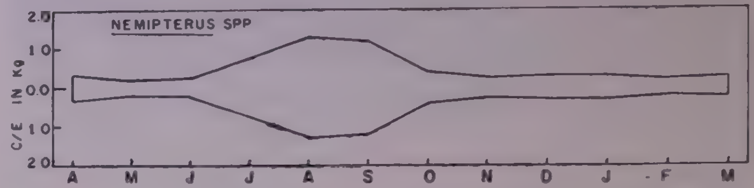

Fig. 33. Seasonal abundance of threadfin breams at Vizhinjam.

PLATYCEPHALIDAE

Popular English Name : Flat-heads
Vernacular Name (Malayalam) : 'Oratha'
Annual average catch : 27.8 t
Percentage in total catch : 0.44
Fishing methods and their contribution : Konchu vala: 0.39%
Hooks & line: 0.02%
Boat seine: 0.01%
Drift net: 0.03%

POMADASYIDAE

Popular English Name : Grunters
Vernacular Name (Malayalam) : 'Cheymeen'
Annual average catch : 5.1 t
Percentage in total catch : 0.08
Fishing methods and their contribution : Hooks & line: 0.01%
Konchu vala: 0.06%
Boat seine: 0.01%

PRIACANTHIDAE

Popular English Name : Bull's eye
Vernacular Name (Malayalam) : 'Kanna pola'
Annual average catch : 29.8 t
Percentage in total catch : 0.47

Fishing methods and their contribution : Drift net: 0.20%
Hooks & line: 0.27%

SCIAENIDAE

Popular English Name : Croackers
Vernacular Name (Malayalam) : 'Tora'
Annual average catch : 96.5 t
Percentage in total catch : 1.51
Fishing methods and their contribution : Boat seine: 1.07%
Shore seine: 0.04%
Hooks & line: 0.07%
Konchu vala: 0.33%

SCOMBRIDAE

Popular English Name : Tunas/Seer fishes Mackerel
Vernacular Name (Malayalam) : 'Choora'/'Neimeen' 'Ayila'
Annual average catch : 1,172.6 t
Percentage in total catch : 18.4
Fishing methods and their contribution : Hooks & line: 9.7%
Drift net: 8.4%
Konchu vala: 0.2%
Shore seine: 0.1%

TUNAS

Popular English Name : Tuna
Vernacular Name (Malayalam) : 'Choora'
Annual average catch : 802.4 t
Percentage in total catch : 12.58
Fishing methods and their contribution : Hooks & line: 8.9%
Drift net: 3.7%

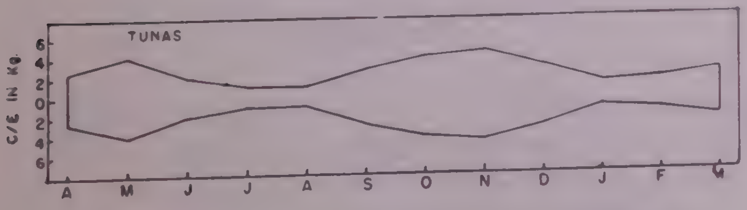

Fig. 34. Seasonal abundance of tunas at Vizhinjam.

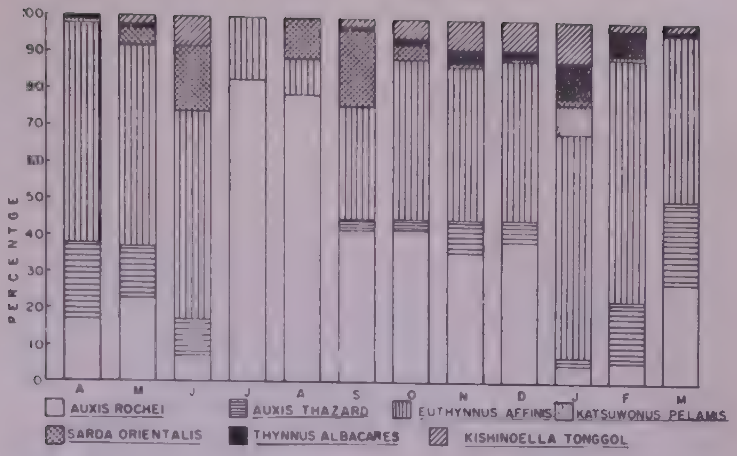

Fig. 35. Monthwise species composition of tunas in indigenous gears at Vizhinjam.

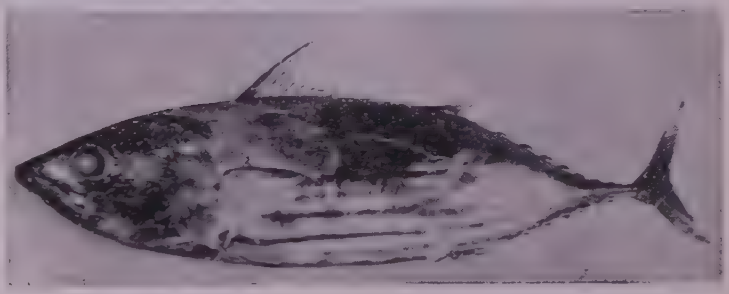

Fig. 36. *Katsuwonus pelamis.*

Scientific Name : *Katsuwonus pelamis*
Vernacular Name : 'Varichoora'
Gear : Hooks & line/ Drift net
Peak period of occurrence : Jan.
Depth of occurrence : 40 - 60 m
Length range in commercial fishery : —
Size at first maturity : —
Spawning season : —

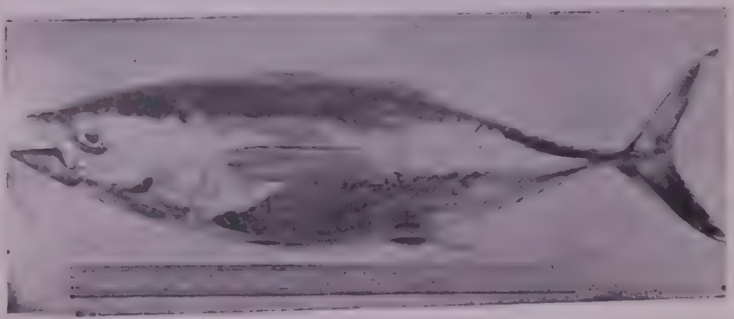

Fig. 37. *Thunnus albacares.*

Scientific Name : *Thunnus albacares*
Vernacular Name : 'Paduvattu choora'
Gear : Hooks & line/ Drift net

Peak period of occurrence : Oct. – Feb.
Depth of occurrence : 40 – 60 m
Length range in commercial fishery : 400 – 800 mm
Size at first maturity : —
Spawning season : —

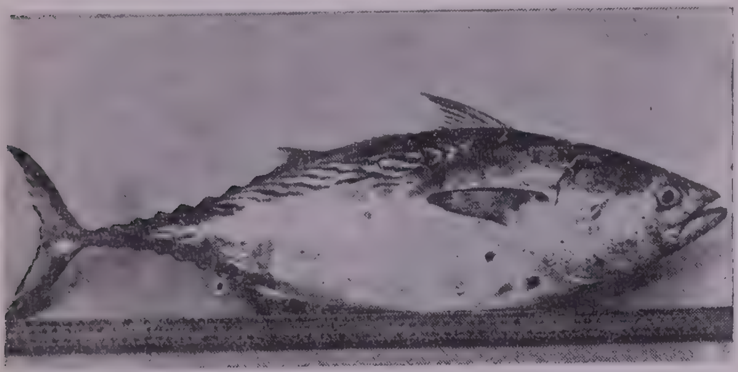

Fig. 38. *Euthynnus affinis.*

Scientific Name : *Euthynnus affinis*
Vernacular Name : 'Kerachoora'
Gear : Hooks & line/ Drift net
Peak period of occurrence : Sep. – Jun.
Depth of occurrence : 40 – 60 m
Length range in commercial fishery : 280 – 720 mm
Size at first maturity : —
Spawning season : —

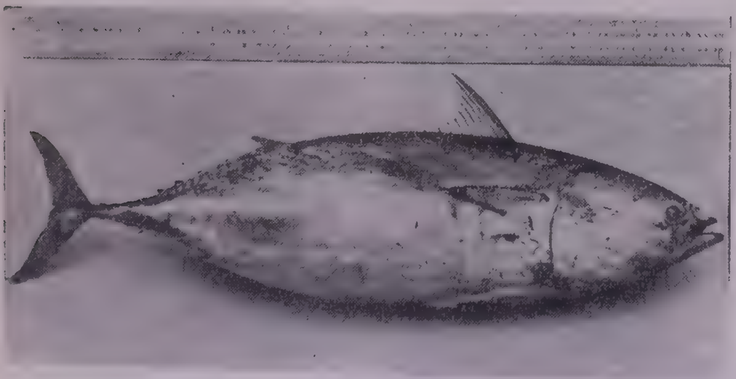

Fig. 39. *Auxis thazard.*

Scientific Name : *Auxis thazard*
Vernacular Name : 'Elichoora'
Gear : Hooks & line/ Drift net
Peak period of occurrence : Feb. – Jun. and Sep. – Dec.
Depth of occurrence : 40 – 60 m
Length range in commercial fishery : 260 – 400 mm
Size at first maturity : —
Spawning season : —

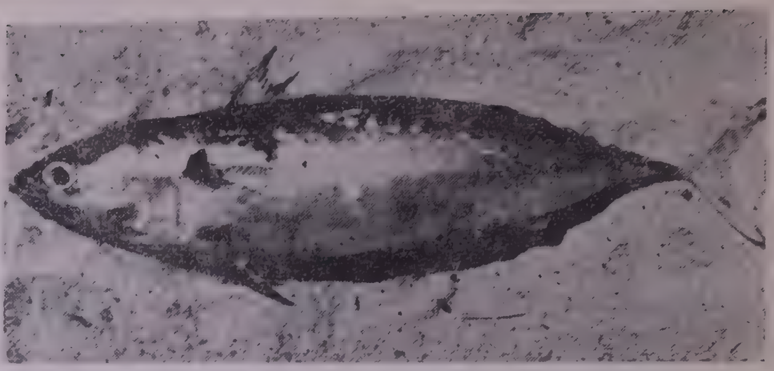

Fig. 40. *Auxis rochei.*

Scientific Name : *Auxis rochei*
Vernacular Name : 'Urulan choora'
Gear : Hooks & line/ Drift net
Peak period of occurrence : Jul. – Dec.
Depth of occurrence : 30 – 60 m
Length range in commercial fishery : 180 – 280 mm
Size at first maturity : —
Spawning season : —

SEER FISHES

Popular English Name : Seer fishes
Vernacular Name (Malayalam) : 'Neimeen'
Annual average catch : 144.7 t
Percentage in total catch : 2.27
Fishing methods and their contribution : Drift net: 2.20 %
Hooks & line: 0.01 %

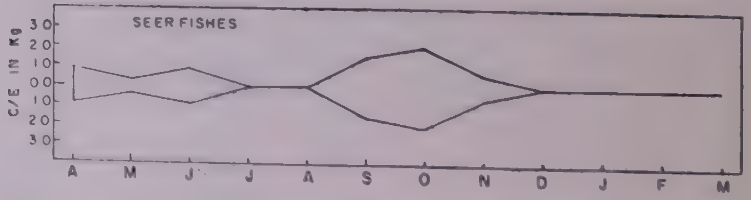

Fig. 41. Seasonal abundance of seer fishes at Vizhinjam.

MACKEREL

Popular English Name : Indian mackerel
Vernacular Name (Malayalam) : 'Ayila'
Annual average catch : 225.5 t
Percentage in total catch : 3.54

Fishing methods and their contribution : Drift net : 2.60%
Konchu vala: 0.17%
Hooks & line: 0.80%
Shore seine: 0.05%
Boat seine: 0.05%

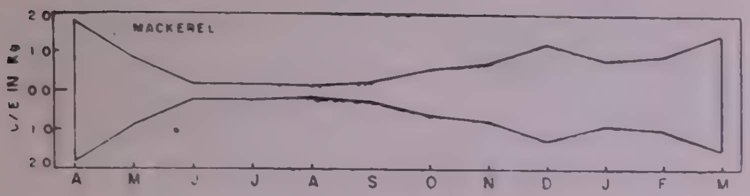

Fig. 42. Seasonal abundance of mackerel at Vizhinjam.

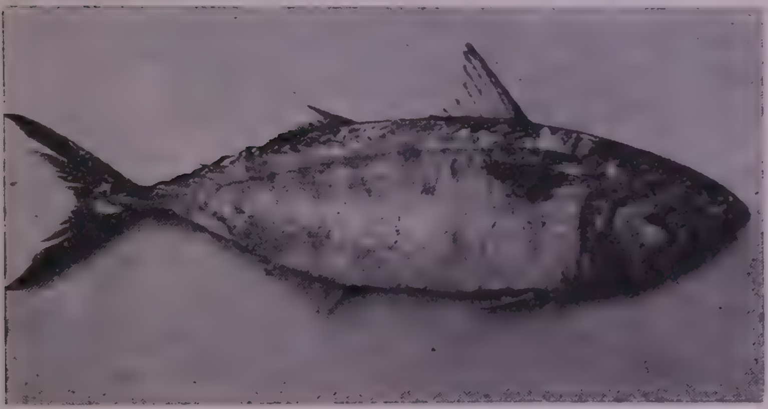

Fig. 43. *Rastrelliger kanagurta.*

Scientific Name : *Rastrelliger kanagurta*
Vernacular Name : 'Ayila'
Gear : Hooks & line/ Shore seine/Boat seine/Drift net/ Chala vala/ Konchu vala
Peak period of occurrence : Nov. – May
Depth of occurrence : Upto 60 m
Length range in commercial fishery : 65 – 300 mm
Size at first maturity : —
Spawning season : Mar. – Jun. and Sep. – Oct.

SERRANIDAE

Popular English Name : Rock cods
Vernacular Name (Malayalam) : 'Kalava'
Annual average catch : 14.7 t
Percentage in total catch : 0.23
Fishing methods and their contribution : Drift net: 0.05%
Hooks & line: 0.13%
Boat seine: 0.05%

SILLAGINIDAE

Popular English Name : Whiting
Vernacular Name (Malayalam) : 'Kilimeen'
Annual average catch : 11.8 t
Percentage in total catch : 0.18
Fishing methods and their contribution : Boat seine: 0.18%

SPHYRAENIDAE

Popular English Name : Barracudas
Vernacular Name (Malayalam) : 'Seelavu'/'Neduva'
Annual average catch : 61.0 t
Percentage in total catch : 0.95
Fishing methods and their contribution : Drift net: 0.43%
Chala vala: 0.08%
Hooks & line: 0.09%
Boat seine: 0.33%
Shore seine: 0.01%

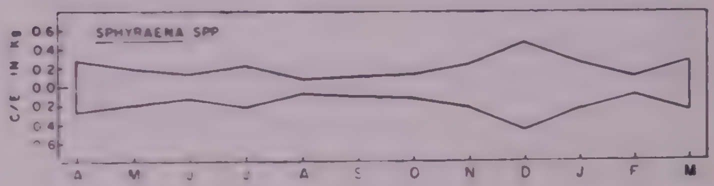

Fig. 44. Seasonal abundance of barracudas at Vizhinjam.

STROMATEIDAE

Popular English Name : Pomfrets
Vernacular Name (Malayalam) : 'Avoli'
Annual average catch : 14.6 t
Percentage in total catch : 0.23
Fishing methods and their contribution : Boat seine : 0.09%
Drift net : 0.14%

SYNODONTIDAE

Popular English Name : Lizard fishes
Vernacular Name (Malayalam) : 'Arana meen'
Annual average catch : 41.6 t
Percentage in total catch : 0.65

Fishing methods and their contribution : Hooks & line: 0.51 %
Konchu vala: 0.09 %
Chala vala: 0.04 %
Boat seine: 0.01 %

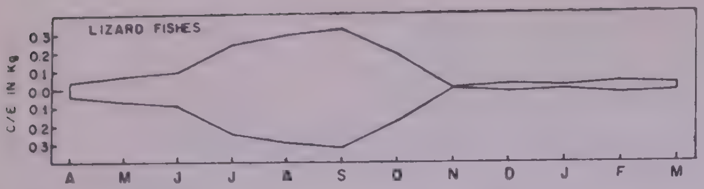

Fig. 45. Seasonal abundance of lizard fishes at Vizhinjam.

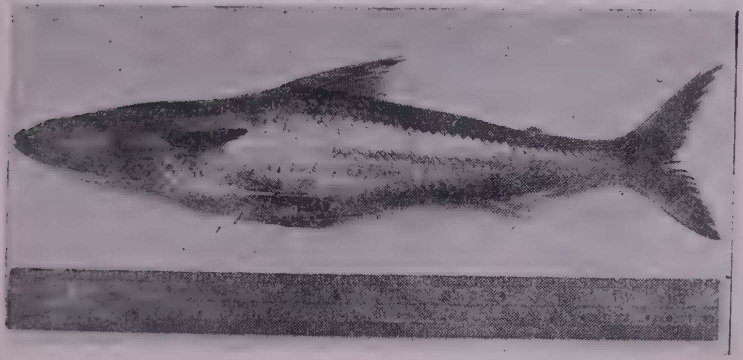

Fig. 46. *Saurida tumbil.*

Scientific Name : *Saurida tumbil*
Vernacular Name : 'Arana meen'
Gear : Hooks & line/ Chala vala/ Konchu vala
Peak period of occurrence : Jul. – Aug.
Depth of occurrence : 20 – 40 m
Length range in commercial fishery : 130 – 349 mm
Size at first maturity : —
Spawning season : Aug. – Sep.

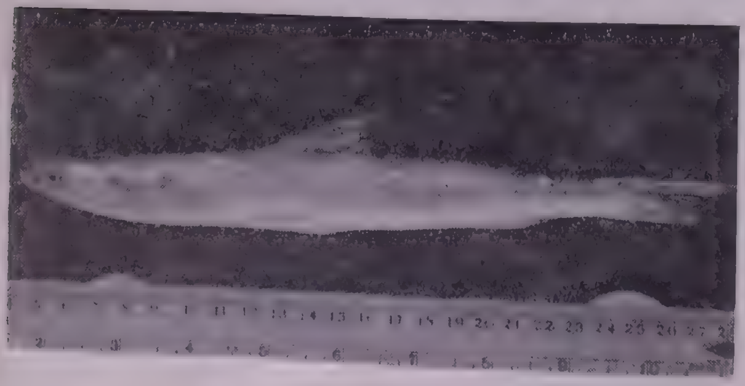

Fig. 47. *Saurida undosquamis.*

Scientific Name : *Saurida undosquamis*
Vernacular Name : 'Arana meen'
Gear : Chala vala/ Konchu vala/ Hooks & line
Peak period of occurrence : Feb. - Mar., May – Jun. and Sep. – Oct.
Depth of occurrence : 20 – 40 m
Length range in commercial fishery : 50 – 329 mm
Size at first maturity : —
Spawning season : Aug. –Sep.

TACHYSURIDAE

Popular English Name : Cat fishes
Vernacular Name (Malayalam) : 'Thedu'
Annual average catch : 85.4 t
Percentage in total catch : 1.34
Fishing methods and their contribution : Drift net : 0.26 %
Hooks & line: 0.74 %
Boat seine : 0.30 %
Konchu vala: 0.04 %

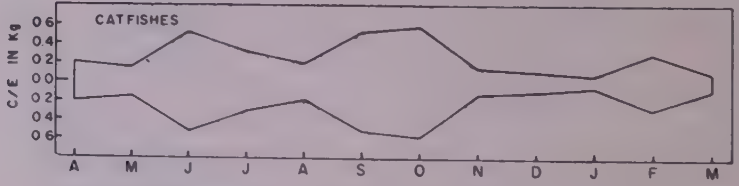

Fig. 48. Seasonal abundance of cat fishes at Vizhinjam.

THERAPONIDAE

Popular English Name : Thorn fish/ Crescent perch
Vernacular Name (Malayalam) : 'Keeli'
Annual average catch : 25.5 t
Percentage in total catch : 0.40
Fishing methods and their contribution : Hooks & line: 0.19 %
Drift net: 0.02 %
Konchu vala: 0.16 %
Boat seine: 0.03 %

TRICHIURIDAE

Popular English Name : Ribbon fishes
Vernacular Name (Malayalam) : 'Vaala'/'Chunnambu vaala'
Annual average catch : 1698.8 t
Percentage in total catch : 26.65
Fishing methods and their contribution
Boat seine: 25.80%
Hooks & line: 0.43%
Drift net: 0.43%

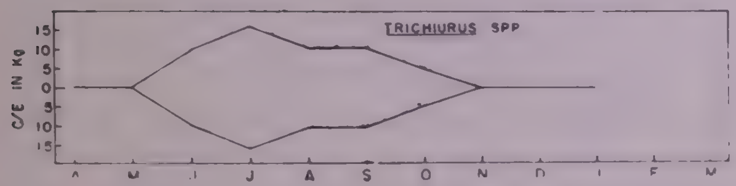

Fig. 49. Seasonal abundance of ribbon fishes at Vizhinjam.

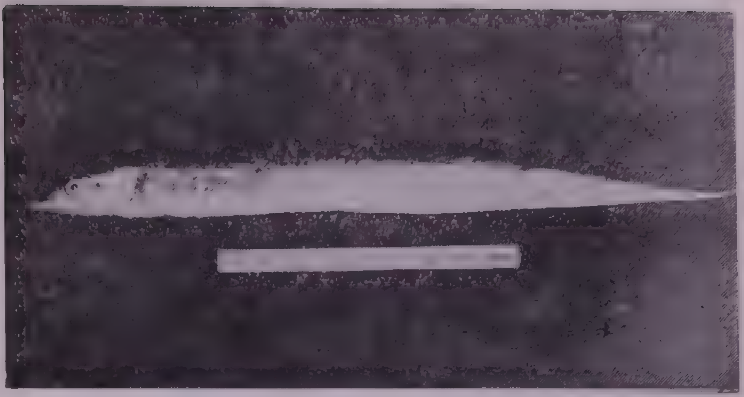

Fig. 50. *Trichiurus lepturus.*

Scientific Name : *Trichiurus lepturus*
Vernacular Name : 'Chunnambu vaala'
Gear : Boat seine
Peak period of occurrence : Jun. – Sep.
Depth of occurrence : 15 – 40 m
Length range in commercial fishery : 640 – 1130 mm
Size at first maturity : —
Spawning season : Jul. – Sep.

PRAWN FISHERY BY THE 'BIG TRAWLERS' ALONG THE NORTHEAST COAST

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Introduction

The traditional fishery for prawns along the northeast coast with different varieties of shore seines and boat seines has been restricted to a narrow strip of coastal waters. With the advent of mechanisation, the fishing pattern has undergone drastic changes in the past two decades. Commercial trawling for prawns by small mechanised boats of 10–11 m length with 45–70 HP diesel engines, started towards the end of 1967 at Visakhapatnam, has expanded by leaps and bounds. Some of these boats ventured fishing along the Orissa coast in 1973 met with success. Thus there developed a sizable fleet operating from Paradeep althrough the year. However, due to limited endurance these small mechanised boats are not capable of harvesting the vast areas of the Sandheads and the adjacent grounds. Two 'big trawlers' of 24 m over-all-length (Gulf of Mexico type) imported from the USA which started fishing for prawns in this area in 1972 found that this type of boats could be operated successfully in these waters. The economic viability of these two boats paved the way for the development of a fishery based on these big trawlers. In recent years there has been a gradual increase in the number of these boats and in 1986 about 100 big trawlers were in operation. Another interesting development was the introduction of 'mini trawlers' (16 m OAL) at the end of 1985 which became the craze of the industry in 1986. About 27 of these 'mini trawlers' were in operation in 1986 from

Visakhapatnam. These trawlers (large trawlers and mini trawlers) operate from Visakhapatnam since infrastructural facilities are available only at this harbour. Some of the boats operated from Roychowk harbour during 1983-'84 found it difficult to operate from this harbour and abandoned the idea once for all inspite of the requests from West Bengal. In fact, the vessels of the West Bengal Fisheries Corporation themselves are operating from Visakhapatnam.

Rao *(Indian J. Fish.,)* gave a preliminary account of the fishery based on the data of 1983–'84 to 1985–'86 and stock estimation of the prawn resource. In the present account data for 1983–'84 to 1986–'87 are analysed in a detailed way to eulcidate monthly variations as well as annual variations of catch and effort, catch composition, fishing areas and depth distribution.

The fishing fleet and its operations

The big trawlers of 22–25 m OAL are made of steel with 380–450 HP diesel engines while the mini trawlers of 16 m OAL are of wooden make with engines of 145 HP. Salient features of a typical big trawler and a typical mini trawler are given below:

Specifications	Big trawler	Mini trawler
Over-all-length (m)	23.19	16.00
Breadth (m)	7.33	5.08
Draft (m)	3.08	2.15
Horse power of engine	380	145
Gross tonnage (GRT)	115.8	42.0
Registered tonnage (NRT)	78.8	12.8
Crew complement	12	8
Chill tank capacity (t)	3.5	No freezing facility
Chill tank temperature (°C)	–2	–do–
Fish hold capacity (t)	25.0	7.5
Fish hold temperature (°C)	–18	–18
Type of net	Four seam shrimp trawl	Four seam shrimp trawl
Length of head rope of net (m)	26.25	21.54
Codend mesh size (mm)	30	25
Dimensions of otter boards (m)	3.0 x 1.2	1.8 x 0.8
Weight of otter boards (kg)	200	75
Trawling speed in knots	2.5	3.0

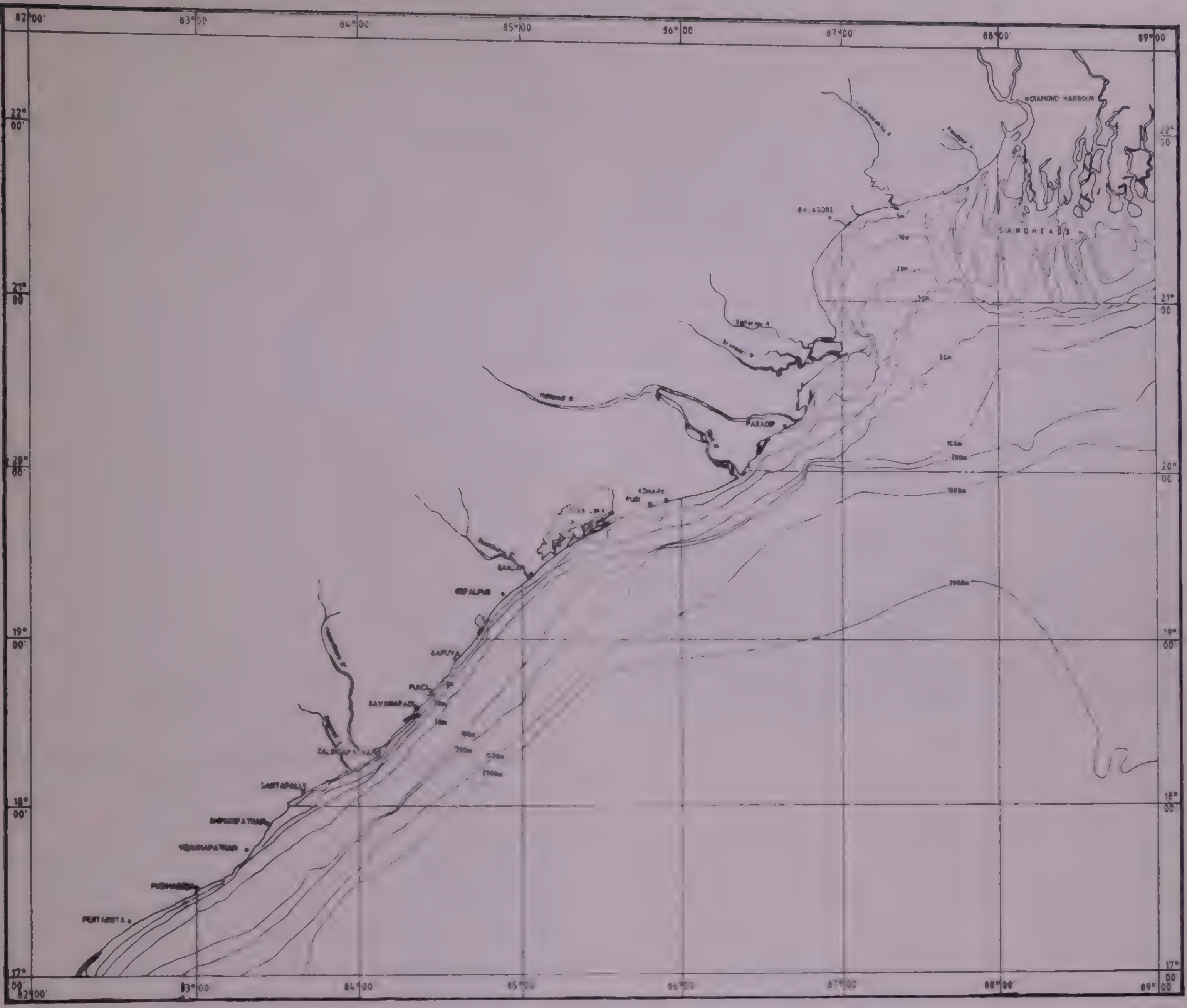
Both the types of vessels are provided with echo-sounder and radiotelephone. The large trawlers have freezing facility on board the vessels, while the mini trawlers do not have such a facility. They carry ice in the fish hold and store the catch in ice. The large rawlers could stay at sea for 18–23 days while the mini-trawlers can stay only for 8-10 days. Although they operate from Visakhapatnam, very often they take shelter in Paradeep Harbour whenever the sea is rough and not possible to conduct fishing. As the weather in the northern Bay of Bengal is highly unpredictable, the time spent by these vessels at Paradeep is quite considerable.

The vessels operate two identical nets simultaneously from the outriggers on both sides of the boat. Generally a haul lasts for about 3–4 hours, although hauls of upto 6 hours duration are quite common. Daily a boat conducts operations for about 15–20 hours if not hampered by bad weather and mechanical failures. All these boats conduct aimed trawling for penaeid prawns. However, a good quantity of fish are also caught. Most of the fish catch is composed of low quality species and hence is discarded immediately, retaining only quality fishes such as pomfrets, seers, eels, tunas, polynemids, catfishes and perches. The amount of by-catch discarded at sea varies from vessel to vessel and in the same vessel from haul to haul and season to season. None of the vessels keep any records of these discards and hence it is not possible to estimate the total catch of these trawlers.

The big trawlers generally operate between Pentakota (17°N lat.) in the south aad Sunderbans (21°N lat.) in the north including the vast areas of the Sandheads (Fig. 1). Although they fish over wider areas, most of the effort is expended between Gopalpur (19°N lat.) and the Sunderbans (21°N lat.). These vessels generally fish in the depth range of 40–80 m and rarely in 10–40 m and beyond 80 m depth ranges.

Retrieval and analysis of data from the fishing logs

Most of these trawlers maintain a regular fishing log. However, there is no uniformity in the fishing log of different vessels. For the sake of uniformity the data have been transformed to yield data on effort in sea days, fishing days, fishing hours and catch of total prawns and composition of 'tiger', 'white', 'brown' and 'others' in the landings. Any ambiguity observed in the fishing logs was got clarified by discussions with crew of the vessels. Some of the vessels could not provide fishing log. Hence, the data are extrapolated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BALASORE
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50m
100m
200m
1000m
2000m
PARADIP
KONARK
PURI
GOPALPUR
BARUVA
KALINGAPATNAM
SANTAPALLE
VISAKHAPATNAM
PENTAKOTA

Fig. 1. Map showing the northeast coast of India with depth contours.

to the total number of vessels operated based on the data for which fishing logs were available. The accessibility to fishing logs of vessels in different years is as follows:

Years	Vessels for which fishing log was available	Total number of vessels operated
1983–'84	13	55
1984–'85	38	60
1985–'86	43	76
1986–'87	45	91 + 9

None of the mini trawlers could provide data. Observations at the landing centre indicated that the prawn landings of three mini trawlers were equal to one big trawler. Hence, 27 mini trawlers are standardised as 9 large trawlers in 1986–'87.

A species-wise breakup of the prawn catch was not possible since the catch is recorded as 'headless tiger', 'headless white', 'headless brown' and 'headless flower'. However, the species composition of different categories was found to be as follows:

'Tigers' : *Penaeus monodon, P. semisulcatus* and *P. japonicus*

'Whites' : *P. indicus, P. merguiensis* and *P. penicillatus*

'Browns' : *Metapenaeus monoceros, M. ensis* and *M. affinis*
'Flowers' : *M. brevicornis* and *M. dobsoni*

Fishing hour or trawling hour *i.e.*, the time actually spent in trawling was taken as a standard unit of effort than any other time unit such as sea day, fishing day and fishing haul and the catch obtained for one hour of trawling or catch per hour of trawling (CPH) was considered as an index of abundance. While analysing the data month-wise, the data of landing at Visakhapatnam was taken as the criterion to include the voyage in that month irrespective of the month of departure.

The fishery

Catch and effort

Monthly distribution of effort in terms of voyages, sea days, fishing days and fishing hours for the four-year period 1983–'84 to 1986–'87 is shown in figures 2–5. With the increase in the number of vessels in the fishing fleet from 55 in 1983–'84 to 100 in 1986–'87, the effort in respect of voyages, sea days, fishing days and fishing

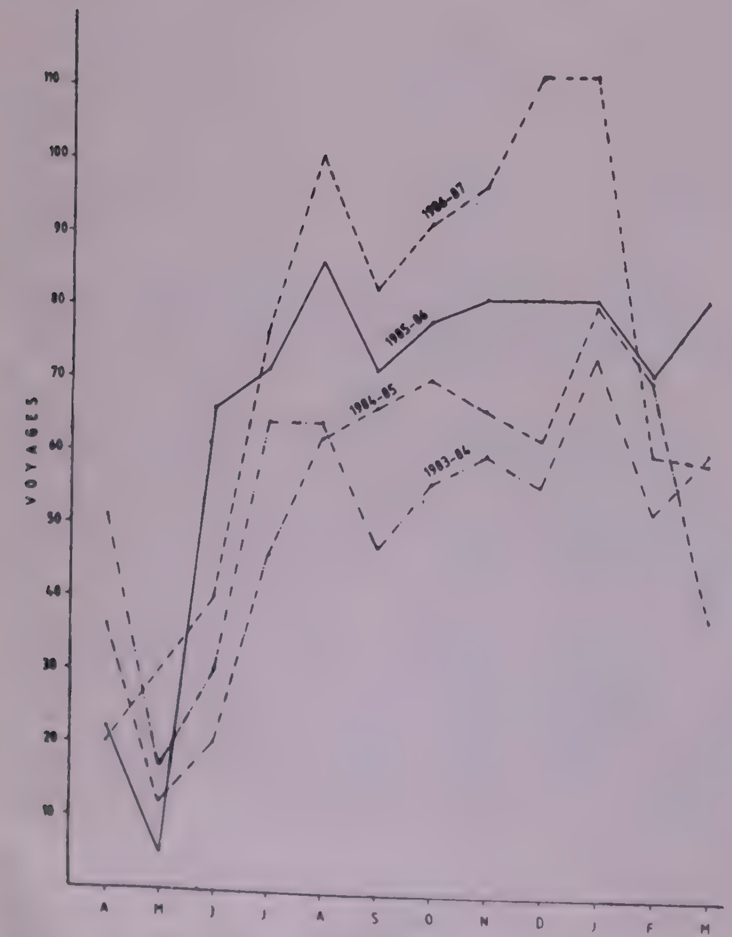


Fig. 2. Monthly effort of big trawlers during 1983–'84 to 1986–'87.

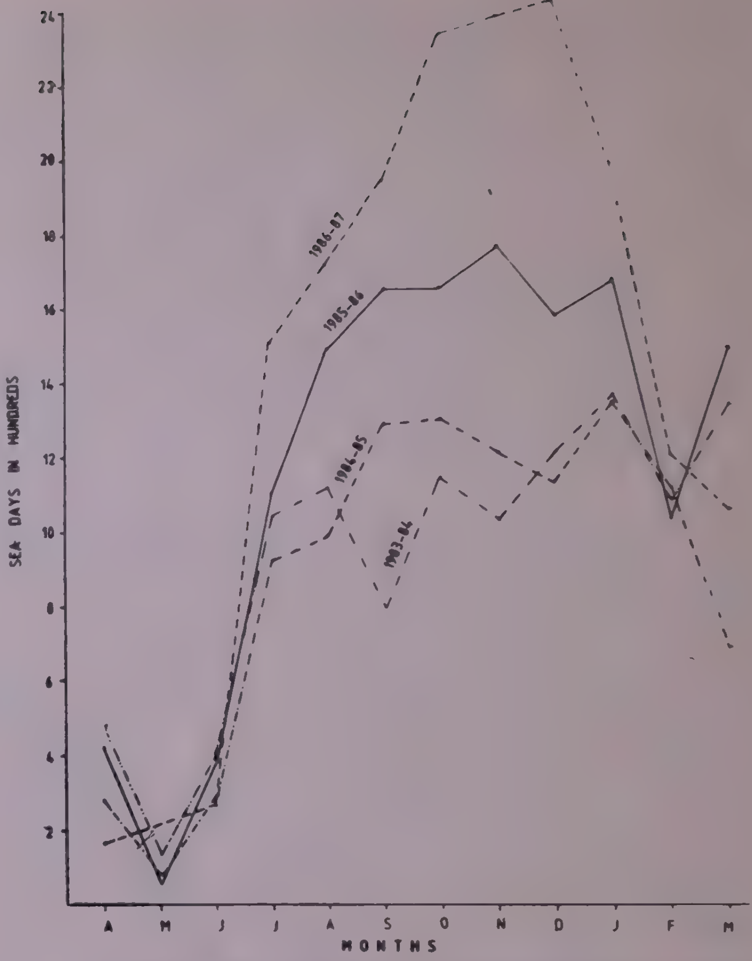


Fig 3. Monthly effort in sea days of big trawlers during 1983–'84 to 1986–'87.

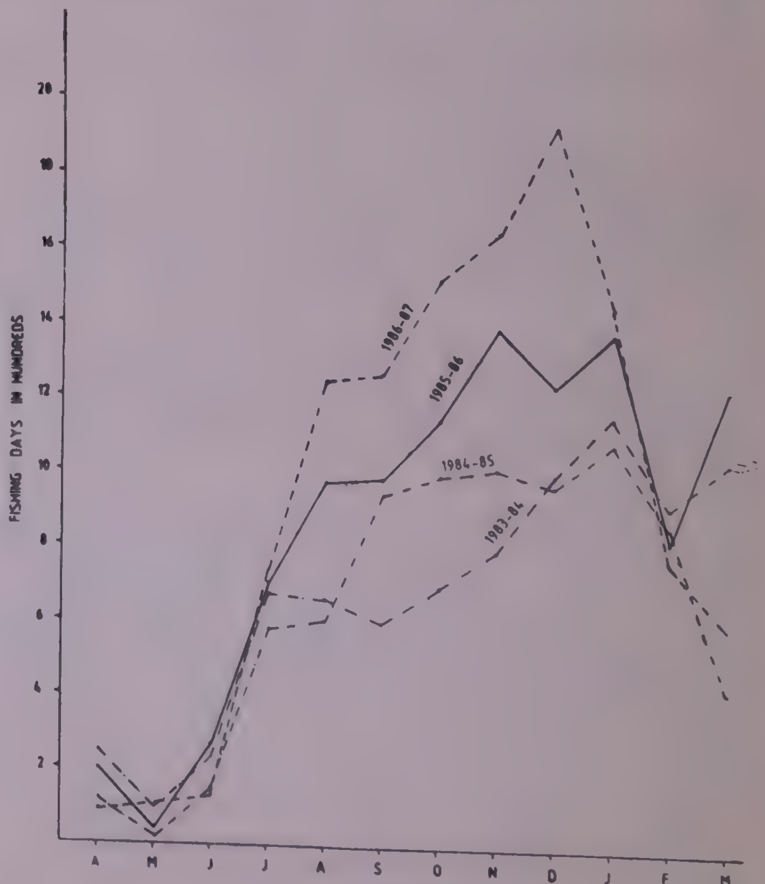


Fig. 4. Monthly effort in fishing days of big trawlers during 1983–'84 to 1986–'87.

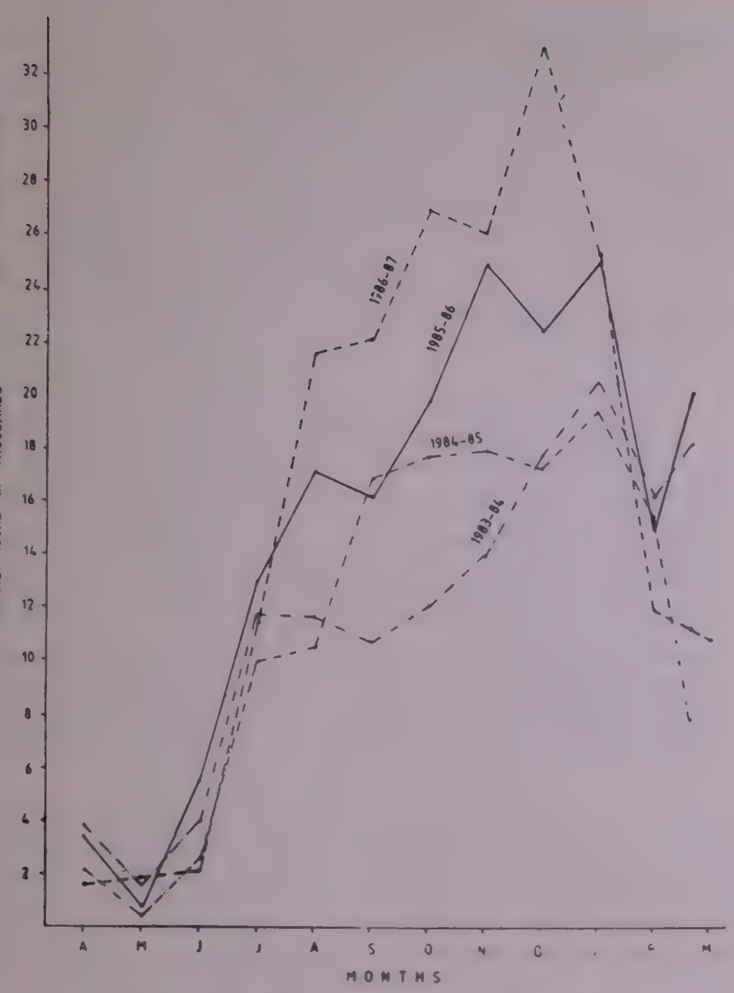


Fig. 5. Monthly effort in fishing hours of big trawlers during 1983–'84 to 1986–'87.

hours gradually increased during the period under study. Fishing effort is at a minimum during April - June, from when gradually increased to reach a peak during October - December and then declined gradually to March. This trend was followed in more or less all the four years for which data are available.

Data on monthly prawn landings and CPH for prawns for the four-year period are presented in figures 6 and 7 and the annual data on catch and effort is presented in Table 1. In 1983–'84 an estimated 2,353 t of prawns were landed by 55 vessels operated during that year. These vessels fished for about 143,961 trawling hours recording a CPH of 16.3 kg. Prawn landings varied from 10.8 t in May to 395.5 t in January while the CPH varied from 5.9 kg in April to 27.2 kg in October. Almost 55% of annual quantity was landed in October–January. The fishery realised Rs. 180.1 million (ex-vessel) during this year.

In 1984–'85, 60 vessels landed 2,815.5 t of prawns for an effort of 139,929 trawling hours with a CPH of 20.1 kg. Prawn landings gradually increased from 1.8 t in May to 431.2 t in September and then declined to 64.9 t in March while the CPH increased from 5.2 kg in May to 28.5 kg in November and then declined to 8.0 kg in March (Figure 7). The fishery realised Rs. 225.2 million during this year.

The annual prawn landings in 1985–'86 were estimated at 3,043.0 t for an effort of 184,874 trawling hours expended by 75 vessels. The increase in the landings was only 7% while the increase in effort was 24%. Prawn landings gradually increased from May (20.3 t) till November (471.0 t) and then declined gradually till May, whereas the CPH gradually increased from July (15.7 kg) to September (21.7 kg) and then declined gradually till February (9.2 kg) with the average estimated at 16.3 kg. During the year the landings were valued at Rs. 272.9 million, an increase of over 21% from that of the previous year.

In 1986–'87, 100 vessels (91+9) landed an estimated 3,077.5 t of catch for an effort of 195,300 trawling hours with an average CPH of 15.8 kg. Although the increase in effort was 5% the increase in catch was only 1%. Prawn landings gradually increased from June (45.8 t) till December (558.9 t) and then declined till March (84.2 t) while the CPH increased from 16.1 kg

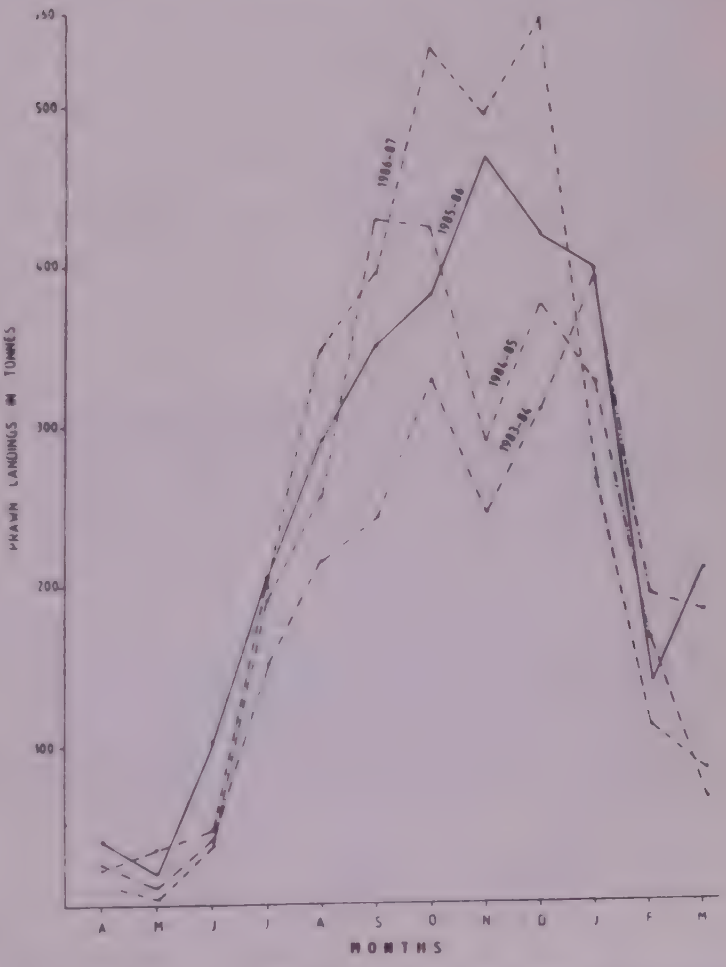


Fig. 6. Monthly prawn landings by big trawlers during 1983–'84 to 1986–'87.

in August to 19.8 kg in October and then declined gradually to 7.6 kg in March. The annual landings were valued at Rs. 375.1 million, an increase of over 27% over that of the previous year.

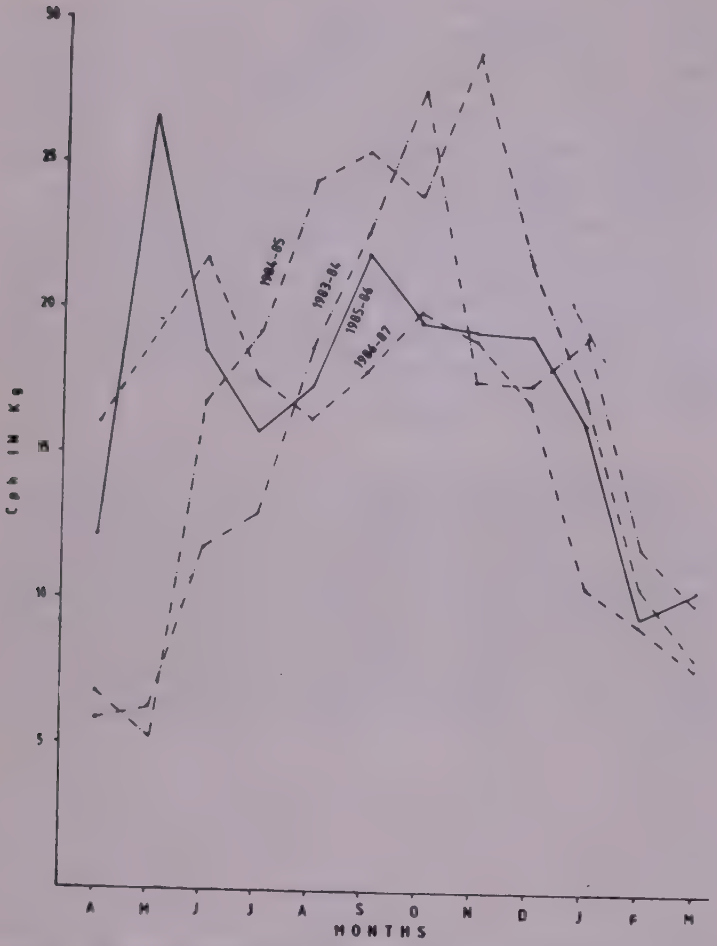


Fig. 7. Monthly CPH by big trawlers duriug 1983–'84 to 1986–'87.

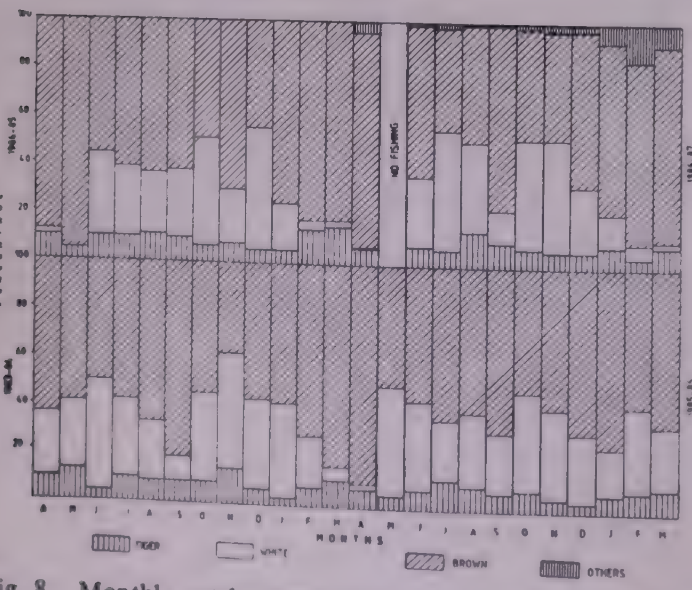


Fig. 8. Monthly catch composition of prawn landings of big trawlers during 1983–'84 to 1986–'87.

Catch composition

The catch was composed of 'tigers' (8.1%), 'whites' (29.9%), 'browns' (60.7%) and 'others' (1.3%). The proportion of 'others' in the first three years was negligible. Monthwise percentage composition is presented in Fig. 8. It is observed that 'browns' dominated the catches in almost all the months followed by 'whites' and 'tigers'.

'Tigers': Monthly landings and CPH of 'tigers' during the four-year period are presented in Fig. 9. The landings of tigers in 1983–'84 were estimated at 194.3 t, forming about 8.3% of the annual prawn landings. The landings gradually increased from May (1.4 t) till November (34.3 t) and then decreased in December and January followed by an increasing trend till March (20.4 t). CPH also indicated more or less similar trend with the annual CPH estimated at 1.4 kg.

With an estimated catch of 236.5 t, 'tigers' formed about 8.4% of the prawn landings in 1984–'85 (Table 1). The landings exhibited peaks in September (43.8 t), November (37.7 t) and February (23.0 t) whereas peaks for CPH were observed in August (2.7 kg), November (2.1 kg) and February (1.5 kg). The annual average CPH was recorded at 1.7 kg against 1.4 kg of the previous year.

233.5 t of 'tigers', forming about 7.7% of the prawn landings, were landed in 1985–'86. The peaks in the landings were observed in August (30.4 t), October (33.7 t), January (32.6 t) and March (19.9 t). The CPH also followed the same trend. The average CPH was 1.3 kg, about 0.4 kg lesser than that of the previous year.

With an estimated catch of 255.4 t, 'tigers' formed about 8.3% of the prawn landings in 1986–'87 (Table 1). The landings exhibited peaks in August (48.8 t), October (41.9 t) and December (38.0 t) while the CPH gradually declined from August (2.3 kg) till February (0.4 kg). Annual CPH did not vary from 1.3 kg recorded in the previous year.

'Whites': Annual landings varied from 719.7 t in 1983–'84 to 954.4 t in 1986–'87 (Table 1) while the CPH varied from 4.8 kg in 1985–'86 to 5.8 kg in 1984–'85. Month-wise landings and CPH of 'whites' are presented in Fig. 10. During 1983–'84, the landings for 'whites' exhibited peaks in August (53.6 t), October (121.6 t) and January (154.0 t) whereas the peaks in CPH were in June (5.3 kg), October (10.0 kg) and January (7.4 kg).

Table 1. *Catch and effort of big trawlers operating from Visakhapatnam during the years 1983–'84 to 1986–'87*

Particulars		1983–'84	1984–'85	1985–'86	1986–'87
Vessels in operation		55	60	75	100
No. of voyages		630	628	794	847
No. of days at sea		11,051	10,518	14,175	16,843
No. of fishing days		8,071	7,746	10,306	11,344
No. of fishing hours		143,961	139,929	184,874	195,300
Prawn catch in t		2,353.0	2,815.5	3,043.0	3,077.5
CPH in kg		16.3	20.1	16.5	15.8
Catch composition					
Tiger'	Catch in t	194.3	236.6	233.7	255.4
	CPH in kg	1.4	1.7	1.3	1.3
	%	8.3	8.4	7.7	8.3
White'	Catch in t	719.7	812.6	889.4	954.4
	CPH in kg	5.0	5.8	4.8	4.9
	%	30.6	28.9	29.2	31.0
Brown'	Catch in t	1,417.5	1,757.1	1,912.7	1,763.3
	CPH in kg	9.9	12.6	10.4	9.0
	%	60.2	62.4	62.9	57.3
Other prawns catch in t		21.5	9.4	7.2	104.4
Value in millions of Rs.		185.1	225.2	272.9	375.1

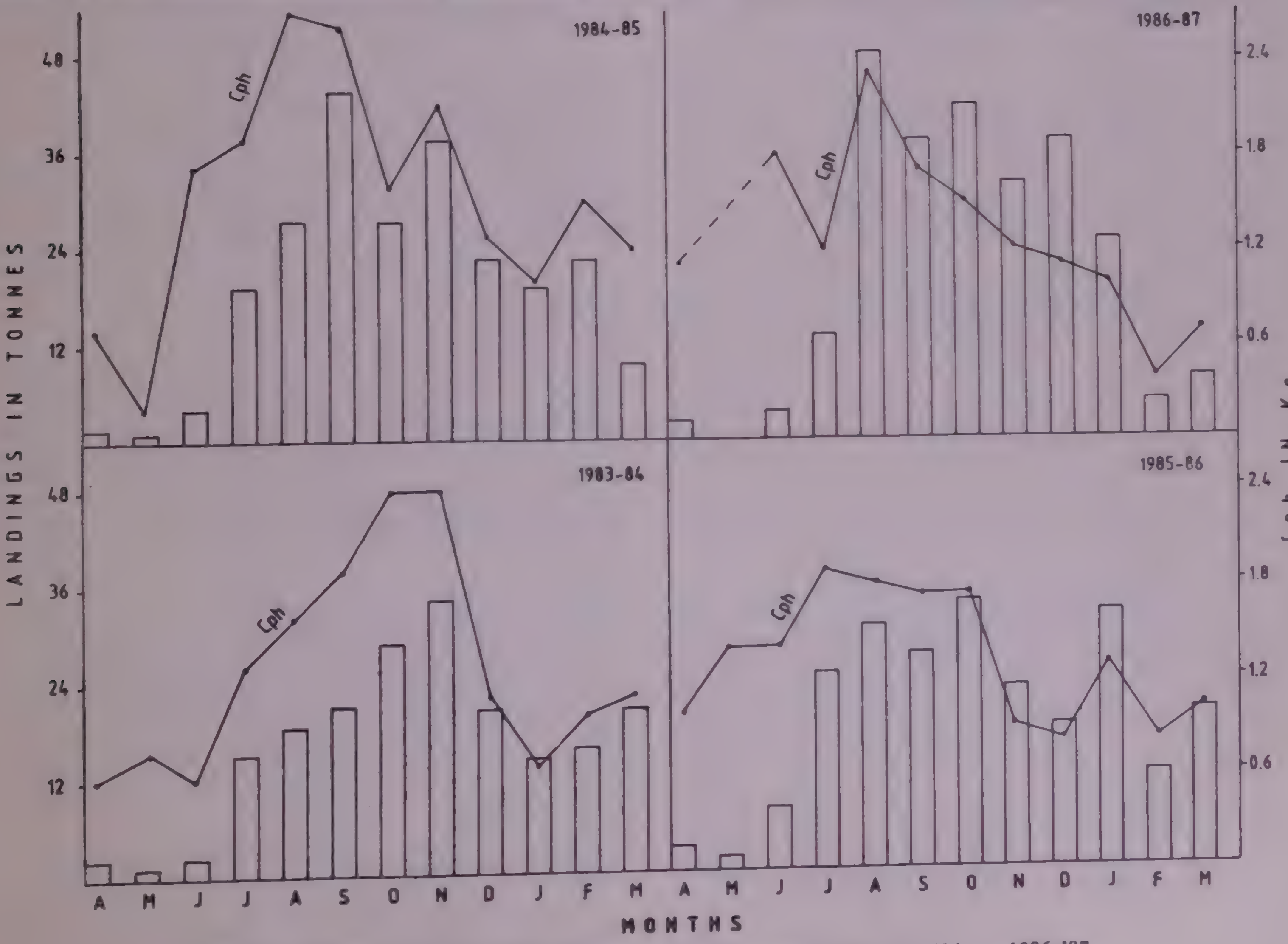


Fig. 9. Monthly catch and CPH of 'tigers' by big trawlers during 1983–'84 to 1986–'87.

Table 2. *Pooled monthly averages of catch and effort of big trawlers operating from Visakhapatnam (Pooled for the period April, 1983 to March, '87)*

Particulars		Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Total
No. of voyages		32	8	39	64	78	66	74	76	77	86	63	60	723
Days at sea		331	67	335	1,137	1,320	1,411	1,597	1,583	1,572	1,575	1,090	1,128	13,145
Fishing days		164	38	194	669	870	943	1,082	1,207	1,277	1.261	840	820	9,365
Fishing hrs.		2,709	704	3,527	11,564	15,267	16,608	19,303	20,924	22,932	2,2921	1,4985	14,572	166,016
Prawn catch in t		25.2	8.2	59.4	1,86.9	279.0	356.4	420.4	432.4	417.6	348.3	152.7	135.5	2,822.0
CPH in kg		9.3	11.6	16.8	16.2	18.3	21.5	21.8	20.7	18.2	15.2	10.2	9.3	17.0
Catch composition														
'Tiger'	Catch in t	1.8	0.6	4.6	18.1	31.3	32.5	33.0	31.8	24.8	22.8	13.4	14.4	229.1
	CPH in kg	0.7	0.9	1.3	1.6	2.1	2.0	1.7	1.5	1.1	1.0	0.9	1.0	1.4
	%	7.1	7.3	7.7	9.7	11.2	9.1	7.8	7.4	5.9	6.5	8.8	10.6	8.1
'White'	Catch in t	1.7	3.0	21.7	63.7	83.4	71.7	176.3	158.9	141.1	80.1	25.7	16.6	843.9
	CPH in kg	0.6	4.3	6.2	5.5	5.5	4.3	9.1	7.6	6.2	3.5	1.7	1.1	5.1
	%	6.7	36.6	36.5	34.1	29.9	20.1	41.9	36.7	33.8	23.0	16.8	12.3	29.9
'Brown'	Catch in t	21.1	4.5	33.0	103.6	163.4	250.0	205.8	236.7	245.3	238.3	108.5	102.4	1,712.6
	CPH in kg	7.8	6.4	9.3	9.0	10.7	15.1	10.7	11.3	10.7	10.4	7.2	7.0	10.3
	%	83.7	54.9	55.6	55.4	58.6	70.1	49.0	54.7	58.7	68.4	71.1	75.6	60.7
	Catch in t	0.6	0.1	0.1	1.5	0.9	2.2	5.3	5.0	6.4	7.1	5.1	2.1	36.4
	CPH in kg	0.2	0.1	0.0	0.1	0.0	0.1	0.3	0.3	0.2	0.3	0.4	0.2	0.2
	%	2.4	1.2	0.2	0.8	0.3	0.7	1.3	1.2	1.6	2.1	3.3	1.5	1.3

Vhites formed about 30.6% of the prawn landings in 983–'84.

With an estimated catch of 889.6 t, 'whites' formed bout 29.2% of the prawn landings in 1985-'86. Although here was an increase in the catch, the CPH sharply leclined as compared to the previous year. The lanlings gradually increased from April (0.8 t) and reached peak in November (172.2 t) and then declined thereafter ill March (53.3 t). The CPH gradually increased from .9 kg in July to 7.7 kg in October and then declined till Aarch (2.6 kg).

The catch was estimated at 954.4 t forming about 1.0% of the prawn landings in 1986-'87. The lanlings increased from June (13.5 t) till October (239.1 t) nd then declined gradually till March (2.2 t). The CPH showed random variations in June–September nd declined from October (8.8 kg) till March (0.2 kg).

Pooled data for the four year period indicate that October–December was the best period for the fishery of 'whites' with better landings and CPH (Table 2). The landings gradually increased from April till October nd then declined gradually till March.

'Browns': With an estimated catch of 1,417.4 t browns' formed 60.2% of the prawn landings in 1983–84 (Table 1). The landings and CPH indicated peaks n September, January and March (Fig. 11). Annual verage CPH was estimated as 9.9 kg with variations rom 3.7 kg in April to 18.1 kg in September.

1757.1 t of 'browns' forming about 62.4% of the prawn landings, were caught in 1984–'85. Compared o the previous year, the increase in landings was about 0% while the average in CPH was about 22%. The andings and CPH exhibited peaks in September, November and January. CPH varied from 4.9 kg in May to 0.0 kg in November with the annual average estimated t 12.6 kg.

With an estimated catch of 1,912.8 t, 'browns' formed bout 62.9% of the prawn landings in 1985–'86. The andings more or less gradually increased from 10.2 t n May to 294.7 t in January. The CPH varied between .2 kg in February to 14.6 kg in September with the nnual average at 10.4 kg.

With an estimated landing of 1,763.3 t, 'browns' ormed about 57.3% of the prawn landings in 1986–'87. The landings as well as CPH declined as compared to 985–'86. The landings varied from 21.1 t in April to 356.1 t in December. The CPH varied from 6.0 kg in March to 13.4 kg in September with the average estimated at 9.0 kg. The CPH in April cannot be taken as an index since effort expended was negligible.

Pooled averages for the four-year period indicate that August – January was the best period for the fishery of 'browns' with about 78% of the catch landed during this period (Table 2). The CPH was also very high during the period as compared to the February – July period.

Distribution and abundance in different areas

Data of two vessels for 1985–'86 and 1986–'87 were analysed to study the abundance of prawns in space and time. During this period these vessels operated from Kalingapatnam (lat. 18°N–long. 84°E) to the Sunderbans (lat. 21°N and long. 89°E). Out of a total effort of 10,438 trawling hours, 32% was expended in Sandheads II (20°N and 88°E), 19% off Balasore and 14% off Chilka (Table 3). The CPH varied from 10.63 kg in Sandheads I to 14.84 kg off Sunderbans. The reason for not putting commensurate effort in areas off Kalingapatnam and off Gopalpur was mainly due to concentration of indigenous gear in these areas. Although the CPH recorded was high off anchorage and off Sunderbans the vessels could not expend more effort due to limited area available for trawling. In general it may be concluded that grounds off Kalingapatnam, Gopalpur, Chilka in the south and off Balasore, anchorage and Sandheads are more productive than the other grounds. Grounds off Chilka, Paradeep and in Sandheads I are better for 'tigers' while grounds off Gopalpur, Chilka and Balasore are better for 'whites'. 'Browns' are better represented in the grounds off Konarak, Sandheads II, off anchorage and Sunderbans than in the other areas.

Month-wise abundance of total prawns in different areas is presented in Table 4. Off Kalingapatnam (18°N and 84°E) the CPH varied from 1.96kg in February to 27.69 kg in September. The CPH varied from 4.44 kg in February to 15.26 kg in October off Gopalpur. It is observed that in many areas high CPH was recorded during August - December period and moderate values in June - July and poor values in February – May.

Month-wise abundance of 'tigers' in different areas is presented in Table 5. The abundance of tigers was more in the grounds off Balasore in July; off Kalingapatnam, in Sandheads II and off Anchorage in August and off Gopalpur, of Chilka lake, off Konarak and off

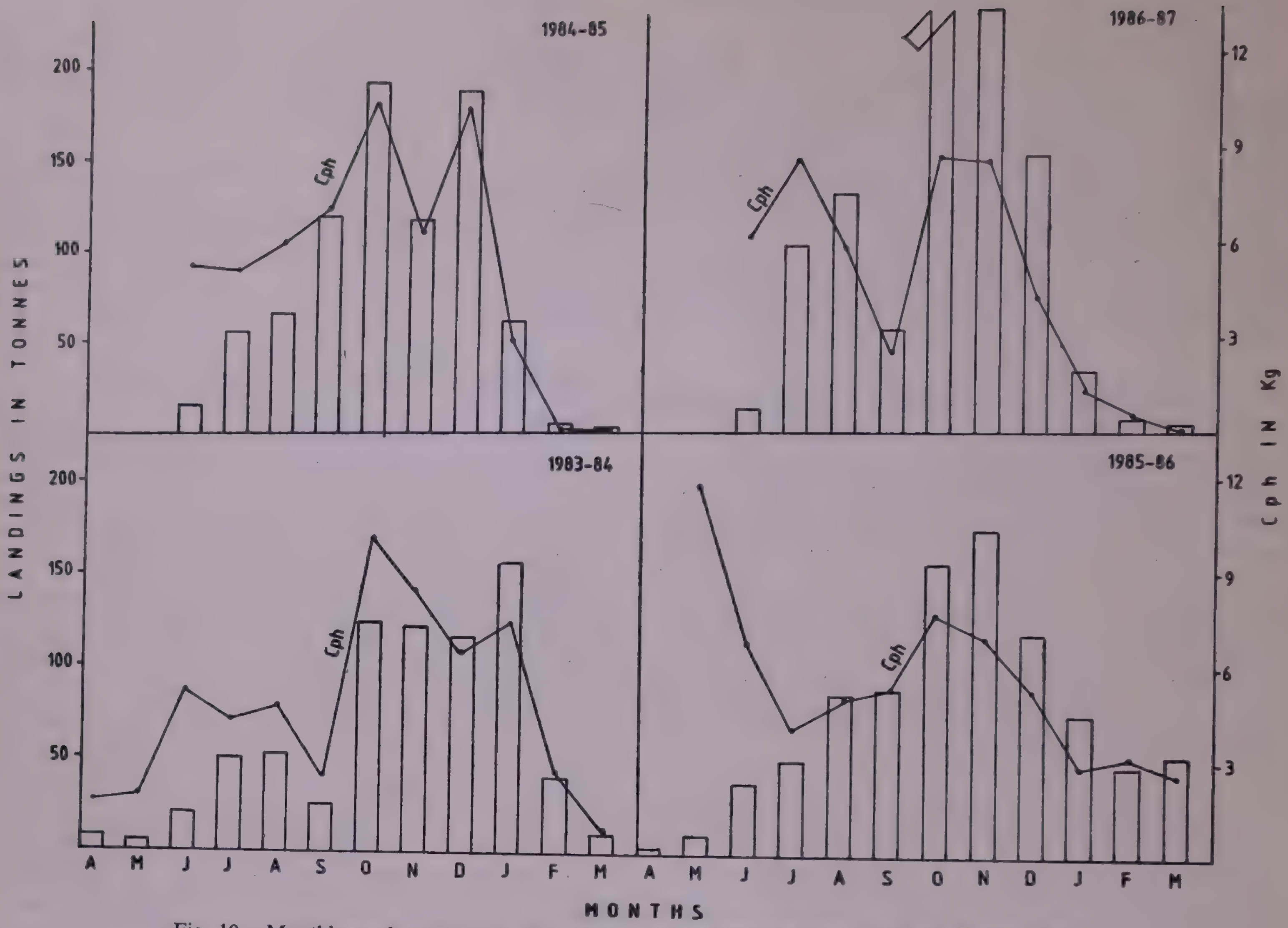


Fig. 10. Monthly catch and CPH of 'whites' by big trawlers during 1983–'84 to 1986–'87.

Table 3. *Abundance of prawns in different areas of northeast coast of India*

Area		Off Kalingapatnam	Off Gopalpur	Off Chilka	Off Konarak	Off Paradeep	Sand heads I	Sand heads II	Off Balasore	Off Anchorage	Off Sundarbans
Latitude °N- Longitude °E		18–84	19–84	19–85	19–86	20–86	20–87	20–88	21–87	21–88	21–89
No. of hauls		38	40	363	67	76	285	772	486	269	84
Trawling time in hrs		146.5	153.3	1,485.3	292.3	325.3	1,159.3	3,308.5	1,934.3	1,188.0	445.8
Prawn catch in kg		1,865	2,012	18,759	3,515	3,531	12,320	39,653	24,280	15,024	6,613
CPH in kg		12.73	13.12	12.63	12.03	10.86	10.63	11.99	12.55	12.65	14.84
Catch composition											
'Tiger'	Catch in kg	116	141	2,248	305	528	1,913	2,104	1,518	679	91
	CPH in kg	0.79	0.92	1.51	1.04	1.62	1.65	0.64	0.78	0.57	0.20
'White'	Catch in kg	656	1,262	6,981	518	1,173	4,348	9,816	11,645	1,966	1,194
	CPH in kg	4.48	8.23	4.70	1.77	3.61	3.75	2.97	6.02	1.65	2.68
'Brown'	Catch in kg	1,093	609	9,550	2,692	1,830	6,059	27,733	11,117	12,379	5,328
	CPH in kg	7.46	3.97	6.43	9.21	5.63	5.23	8.38	5.74	10.42	11.96

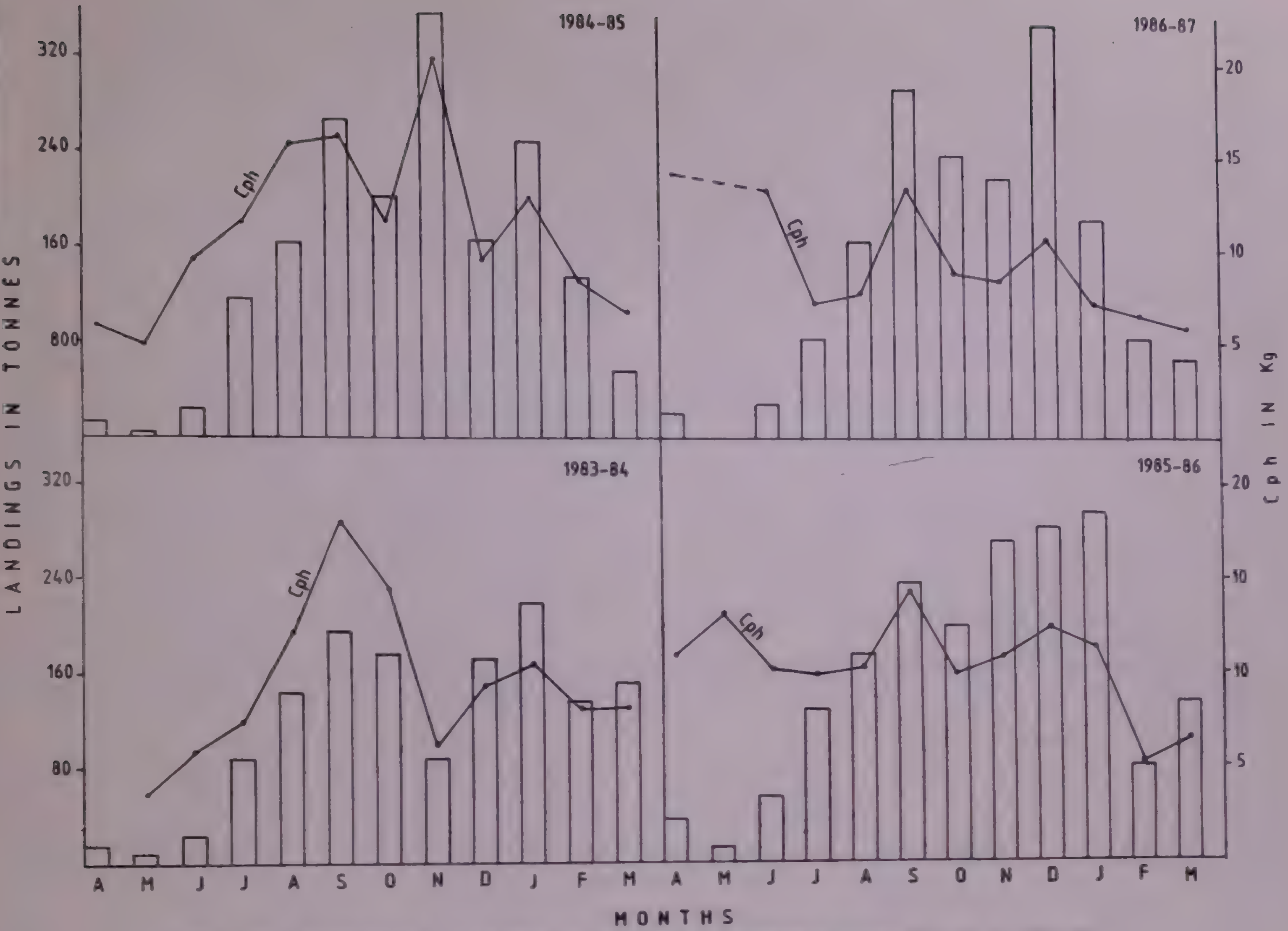


Fig. 11. Monthly catch and CPH of 'browns' by big trawlers during 1983–'84 to 1986–'87.

Table 4. *Month-wise abundance of prawns (CPH in kg) in different areas of northeast coast of India*

Latitude °N– Longitude °E	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Annual
18–84	—	—	12.57	14.88	11.72	27.69	—	5.64	—	—	1.96	—	12.73
19–84	—	—	14.49	11.33	14.37	—	15.26	—	—	—	4.44	6.25	13.12
19–85	2.50	16.51	16.22	13.51	10.47	8.08	11.12	9.84	15.45	3.00	2.74	11.03	12.63
19–86	—	—	—	7.80	16.41	6.00	18.93	—	—	6.85	5.08	—	12.03
20–86	6.37	19.12	—	10.39	13.48	12.75	6.43	—	—	10.79	2.46	6.10	10.86
20–87	—	—	—	8.87	15.91	10.79	11.65	10.96	8.76	7.15	7.33	6.07	10.63
20–88	—	—	—	13.37	11.53	18.39	12.88	13.43	12.85	10.57	8.54	7.96	11.99
21–87	6.87	12.55	—	15.24	13.29	20.60	18.85	14.60	10.47	11.20	7.78	7.94	12.55
21–88	—	—	—	5.00	17.94	16.77	15.03	9.82	9.72	7.50	8.07	6.55	12.65
21–89	—	—	—	—	—	—	—	14.63	15.15	14.56	—	—	14.84

Table 5. *Month-wise abundance of 'tigers' (CPH in kg) in different areas of northeast coast of India*

Latitude °N- Longitude °E	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Annual
18–84	—	—	0.26	0.35	1.79	1.54	—	0.36	—	—	0.17	—	0.79
19–84	—	—	0.90	NC	0.74	—	2.21	—	—	—	1.11	1.25	0.92
19–85	NC	0.75	1.11	1.46	1.98	3.04	5.04	1.30	0.55	NC	0.07	0.50	1.51
19–86	—	—	—	0.35	0.50	NC	2.52	—	—	1.12	0.34	—	1.04
20–86	0.44	1.12	—	1.53	1.42	1.40	3.14	—	—	0.10	0.31	1.08	1.62
20–87	—	—	—	1.09	2.17	1.60	0.55	2.14	0.78	2.73	1.83	1.14	1.65
20–88	—	—	—	1.59	1.76	0.56	0.93	0.62	0.93	0.31	0.11	0.28	0.64
21–87	0.30	1.39	—	2.38	1.81	2.56	0.57	0.22	0.77	1.20	0.42	0.03	0.78
21–88	—	—	—	NC	1.70	0.40	1.10	0.87	NC	0.19	NC	NC	0.57
21–89	—	—	—	—	—	—	—	0.53	0.07	0.19	—	—	0.20

NC = No Catch

Table 6. *Month-wise abundance of 'whites' (CPH in kg) in different areas of northeast coast of India*

Latitude °N- Longitude °E	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Annual
18–84	—	—	4.23	2.08	7.81	12.31	—	3.64	—	—	NC	—	4.48
19–84	—	—	0.12	9.46	8.78	—	12.42	—	—	—	NC	NC	8.23
19–85	NC	10.52	5.25	4.29	4.94	3.60	1.71	0.17	NC	NC	0.02	NC	4.90
19–86	—	—	—	4.39	1.89	NC	0.25	—	—	NC	NC	—	1.77
20–86	NC	10.00	—	1.08	8.14	7.67	NC	—	—	0.10	NC	NC	3.61
20–87	—	—	—	0.11	6.71	2.02	1.39	7.38	6.93	0.07	2.49	1.67	3.75
20–88	—	—	—	3.21	0.53	3.15	6.69	5.22	2.18	1.86	1.13	2.23	2.97
21–87	NC	NC	NC	1.11	5.12	9.40	12.99	9.09	6.37	2.42	4.02	4.67	6.02
21–88	—	—	—	2.50	3.16	0.69	5.10	2.91	—	0.43	0.16	—	1.65
21–89	—	—	—	—	—	—	—	3.24	4.26	0.29	—	—	2.68

NC = No Catch

Table 7. *Month-wise abundance of 'browns' (CPH in kg) in different areas of northeast coast of India*

Latitude °N- Longitude °E	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Annual
18–84	—	—	8.08	12.45	2.12	13.85	—	1.64	—	—	1.79	—	7.46
19–84	—	—	13.47	1.86	3.85	—	0.63	—	—	—	3.33	5.00	3.97
19–85	2.50	5.24	9.86	7.75	3.55	1.44	4.78	8.37	14.90	3.00	2.65	10.53	6.43
19–86	—	—	—	3.06	14.02	6.00	16.16	—	—	5.74	4.75	—	9.21
20–86	5.93	8.00	—	7.78	3.92	3.69	3.29	—	—	7.52	2.15	5.02	5.63
20–87	—	—	—	7.67	7.03	7.17	9.71	1.45	1.04	4.35	3.01	3.25	5.23
20–88	—	—	—	8.57	9.24	14.67	5.27	7.59	9.74	8.40	7.30	5.45	8.38
21–87	6.57	11.16	—	11.75	6.35	8.64	5.29	5.29	3.33	7.58	3.34	3.24	5.74
21–88	—	—	—	2.50	13.09	15.69	8.83	6.04	9.72	6.88	7.91	6.55	10.42
21–89	—	—	—	—	—	—	—	10.91	10.82	14.10	—	—	11.96

Table 8. *Depth-wise distribution of prawn catches of big trawlers during* 1985–'86 *and* 1986–'87 *(Data for 6 vessels pooled)*

Depth in metres		11–20	21–30	31–40	41–50	51–60	61–70	71–80	81–90	91–100
No. of hauls		66	790	1,463	1,362	723	489	431	287	64
Trawling time in hours		201.5	2,820.3	5,549.5	5,714.8	3,280.0	2,226.5	1,883.8	1,286.8	300.5
Prawn catch in kg		3,192	30,527	72,652	59,000	34,971	26,971	25,461	19,036	4,917
CPH in kg		15.46	10.83	13.09	10.32	10.66	12.06	13.51	14.79	16.36
Catch composition										
Tiger'	Catch in kg	50	1,460	4,149	7,213	5,408	1,972	1,343	822	193
	CPH in kg	0.25	0.52	0.75	1.26	1.65	0.88	0.71	0.64	0.64
	%	1.57	4.78	5.71	12.23	15.46	7.31	5.27	4.31	3.93
White'	Catch in kg	2,862	20,638	48,623	19,668	6,766	4,544	2,337	707	114
	CPH in kg	14.20	7.32	8.76	3.44	2.06	2.03	1.24	0.55	0.38
	%	89.66	67.61	66.93	33.34	19.35	16.84	9.18	3.71	2.32
Brown'	Catch in kg	280	8,429	19,880	32,119	22,797	20,455	21,781	17,507	4.610
	CPH in kg	1.39	2.99	3.58	5.62	6.95	9.15	11.56	13.60	15.34
	%	8.77	27.61	27.36	54.44	65.19	75.84	85.55	91.97	93.76

Table 9. *Month-wise abundance of prawns (CPH in kg) in different depth zones of northeast coast of India*

Depth in metres/months	11–20	21–30	31–40	41–50	51–60	61–70	71–80	81–90	91–100
January	—	8.25	6.51	6.54	9.93	10.79	12.53	18.54	—
February	10.79	7.45	6.39	6.94	6.29	9.30	8.06	6.54	—
March	7.50	8.03	6.62	7.53	6.78	7.72	—	—	—
April	—	—	3.33	10.21	—	—	—	—	—
May	—	—	27.97	18.06	15.06	—	—	—	—
June	—	5.63	17.15	14.91	15.42	—	—	—	—
July	—	9.56	13.18	12.08	14.98	7.61	14.00	12.17	—
August	—	10.42	13.30	9.87	9.58	17.47	20.07	14.38	15.23
September	—	12.22	15.03	14.40	13.85	11.85	15.54	18.10	19.34
October	8.00	14.91	17.44	12.43	10.84	11.40	11.27	15.04	21.43
November	22.64	12.94	13.34	9.41	14.95	11.65	14.22	15.10	14.89
December	13.71	11.14	10.94	9.70	11.01	12.48	13.53	14.55	16.67
All Months	15.46	10.83	13.09	10.32	10.66	12.06	13.51	14.79	16.36

— = No operation

Paradeep in October. Generally the abundance was ess in most of the areas during the March-June period.

Month-wise abundance of 'whites' in different areas s indicated by CPH is presented in Table 5. The abundance was more off Kalingapatnam and off Paradeep in August and September while it was more off Gopalpur, Sandheads II, off Balasore and off Anchorage in October: off Sandheads I and off Sunderbans in November and December. CPH was poor in most of the areas during January – June period.

Month-wise abundance of 'browns' as indicated by CPH in different areas is given in Table 7. 'Browns' were abundant in July and September off Kalingapatnam; in June off Gopalpur; in June, December and March off Chilka lake; in August and October off Konarak; in July and January off Paradeep; in July – October in Sandheads I; in July – February in Sandheads II; in July, September and January off Balasore; in August–March off Anchorage and in November – January off Sunderbans.

Abundance of prawns in relation to depth

To study the depth-wise abundance of prawns, data of six vessels from April, 1985 to March, 1987 were analysed. Depth zones were classified as 11–20 m, 21–30 m, 31-40 m *etc.*, to get a clear picture of abundance of prawns based on the CPH obtained in different zones.

Of the 5,675 hours expended by these vessels during the two year period, 50% of the effort was expended in 31-50 m depth range (Table 8). The depths of 21–30 m and 51–80 m were moderately fished and those of 11–20 m and 81–100 m were poorly fished. They never fished beyond 100 m depth.

The abundance randomly fluctuated in 11–40 m depth zone between 10.83 and 15.46 kg while it gradually increased from 41–50 m (10.32 kg) to 91-100 m (16.36 kg). The abundance of 'tigers' as indicated by CPH gradually increased from 11-60 m and then gradually declined beyond this depth. The proportion of 'tigers' in the total prawn catches also indicated a similar trend. The abundance of 'whites' was better in 11-40 m depth and then declined gradually beyond this zone. The proportion of whites gradually declined from 11-20 m (89.66%) to 91-100 m (2.32%). The abundance of 'browns' gradually increased from 11-20 m (1.39 kg) to 91-100 m (15.3 kg). Similarly the proportion of 'browns' in the prawn catches also increased gradually from 11-20 m (8.77%) to 91-100 m (93.76%).

Month-wise abundance of total prawns in different depth zones is presented in Table 9. The abundance of prawn was more in November and December in 11-20 m depth range, September – December in 21-30 m, May – November in 31-40 m, May – October in 41-50 m, May – November in 51-60 m, August — December in 61-70 m, July – January in 71-80 m, August – January in 81-90 m and August – December in 91-100 m depth ranges. In general the abundance was less in February–April in all the depths.

Month-wise abundance of 'tigers' in different depth zones is presented in Table 10. The abundance of tigers was more in October in 11-20 m, August–September in 21-30 m, May–October in 31-40 m, July – March in 41-50 m, May–August and December – February in 51-60 m, January, August and October in 61-70 m, and July – December in 71-80 m depth ranges. In 81-90 m and 91-100 m it was negligible in the catches.

Month-wise abundance of 'browns' in different, depth zones is presented in Table 12. The abundance

Table 10. *Month-wise abundance of 'tigers' (CPH in kg) in different depth zones of northeast coast of India*

Depth in metres/months	11–20	21–30	31–40	41–50	51–60	61–70	71–80	81–90	91–100
January	—	NC	0.14	0.99	2.57	1.48	0.20	0.63	—
February	NC	0.64	0.11	1.27	1.18	0.04	0.24	0.08	—
March	—	0.17	0.44	1.53	0.25	0.12	—	—	—
April	—	—	0.14	0.52	—	—	—	—	—
May	—	—	0.92	0.71	1.37	—	—	—	—
June	—	0.31	1.19	0.98	1.60	—	—	—	—
July	—	0.10	0.40	1.11	1.95	0.87	1.43	0.37	—
August	—	1.47	1.39	2.50	1.72	1.09	1.49	0.63	1.82
September	—	1.32	1.37	1.21	0.38	0.34	0.52	0.37	NC
October	1.33	0.38	1.12	1.02	1.59	1.35	1.44	1.24	NC
November	0.26	0.54	0.63	0.67	0.77	0.72	0.59	0.84	0.53
December	0.16	0.08	0.17	1.13	1.52	0.91	1.42	0.31	0.25
All Months	0.25	0.52	0.75	1.26	1.65	0.88	0.71	0.64	0.64

— = No operation NC = No catch

Table 11. *Month-wise abundance of 'whites' (CPH in kg) in different depth zones of northeast coast of India*

Depth in metres/months	11–20	21–30	31–40	41–50	51–60	61–70	71–80	81–90	91–100
January	—	7.06	2.35	0.23	0.12	0.01	0.03	0.62	—
February	10.35	5.22	3.16	0.39	0.05	0.92	0.12	NC	—
March	4.50	5.89	1.81	0.04	NC	NC	—	—	—
April	—	—	NC	NC	—	—	—	—	—
May	—	—	14.04	6.85	NC	—	—	—	—
June	—	2.19	4.90	4.78	4.72	—	—	—	—
July	—	5.39	9.42	3.56	2.14	NC	3.52	NC	—
August	—	3.33	9.09	3.93	3.47	2.88	2.33	NC	NC
September	—	5.88	8.21	7.79	6.17	1.43	1.13	0.05	NC
October	6.00	8.71	13.22	7.46	2.08	3.26	2.12	0.82	NC
November	21.35	10.78	9.67	4.82	9.39	3.71	2.39	0.69	0.96
December	11.45	9.41	8.60	3.43	2.00	2.76	1.59	0.73	NC
All Months	14.20	7.32	8.76	3.44	2.06	2.03	1.24	0.55	0.38

— = No operation NC = No catch

Table 12. *Month-wise abundance of 'browns' (CPH in kg) in different depth zones of northeast coast of India*

Depth in metres/months	11–20	21–30	31–40	41–50	51–60	61–70	71–80	81–90	91–100
January	—	1.19	4.02	5.31	7.24	9.30	12.30	17.29	—
February	0.44	1.59	3.12	5.28	5.06	8.34	7.70	6.46	—
March	2.50	1.97	4.37	5.96	6.53	7.60	—	—	—
April	—	—	3.19	9.69	—	—	—	—	—
May	—	—	13.01	10.50	13.69	—	—	—	—
June	—	3.13	11.06	9.15	9.10	—	—	—	—
July	—	4.07	3.36	7.41	10.89	6.74	9.05	11.80	—
August	—	5.62	2.82	3.44	4.39	13.50	16.25	13.75	13.41
September	—	5.02	5.45	5.40	7.30	10.07	13.89	17.68	19.34
October	0.67	5.82	3.10	3.95	7.17	6.79	7.71	12.98	21.43
November	1.03	1.62	3.04	3.92	4.79	7.22	11.24	13.57	13.40
December	2.10	1.65	2.17	5.14	7.49	8.81	10.52	13.51	16.42
All Months	1.39	2.99	3.58	5.62	6.95	9.15	11.56	13.60	15.34

— = No operation

of 'browns' was more in August–October in 21–30 m, May–June in 31–40 m, April–July in 41–50 m and May–July in 51-60 m depth ranges. In the depth range of 21–60 m 'browns' were abundant in almost all the months.

General Remarks

The present analysis of the four year data (1983–'84 to 1986–'87) shows that the number of vessels in the fleet increased from 55 in 1983–'84 to 100 in 1986–'87. The effort expended also increased from 143,961 trawling hours in 1983–'84 to 195,300 hours in 1986–'87. Although the landings also increased over the years it is not commensurate with the effort. Catch per hour of trawling (CPH) for total prawns declined gradually from 20.1 kg in 1984–'85 to 15.8 kg in 1986–'87. CPH for 'browns', the dominant component of the prawn landings, also declined from 12.6 kg in 1984–'85 to 9.0 kg in 1986–'87 (see Table 1). The other two groups of prawns, 'tigers' and 'whites', also indicated a decline in CPH over the years. This clearly shows that the fishery has already reached a peak in 1984–'85 and is on a downward trend.

Rao *(Indian J. Fish.,* **34** (4) : 312 – 328*)* estimated the potential resource of prawns between Pentakota and the Sunderbans as 6,577 t and suggested that the stock can withstand the fishing pressure of 104 big trawlers apart from the existing small mechanised boats and indigenous craft. In1986–'87 about 100 big trawlers fished in these waters. Even at this level of effort the CPH has gone down considerably, and it may go down further in 1987–'88 as the number of vessels is likely to increase to 125. It is evident from the available results on catch and effort and potential estimate that the fishery is at the threshold of over fishing, and the time has come to think about the conservation of the resource.

Gulland (In *Penaeid Shrimps - their biology and management,* Fishing News Books Limited, 290–298, 1984) discussed the merits and demerits of the conservation methods applicable to prawn fisheries. The methods in order of priority are:

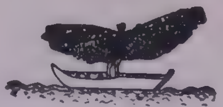
i) Restriction on number of fishing vessels,
ii) imposition of closed season,
iii) regulation of mesh size and
iv) catch quotas.

In the present instance, the industry came forward to impose a ban on fishing for two months, during April 15 to June 15, in 1985–'86 fishing season. However, this self imposed ban did not yield expected results in the ensuing 1986–'87 season as the CPH came down further. The operators observed a closed season for three months, during April 1 to June 30, in 1986–'87 season, although reluctantly. This also is not showing any increasing trend in the catch rate in the current season (1987–'88). So the closed season has not proved to be effective in increasing the catch rates.

Presently most of the trawlers are using nets with codend mesh size of 30 mm. There is no need to increase the mesh size any further.

Another alternative is to fix a catch quota for these boats. This has been attempted in many countries and found it to be a complicated procedure to implement, as this leads to over capitalisation if there is no restriction on the number of vessels owned by a single individual or firm.

Finally, we are left with one alternative namely, restriction of the number of vessels operating on the fishery. If we fail to exercise this restriction, there may be a crisis not only in respect of big trawlers but also for small mechanised boats since both the fleets share the same resource.



SUCCESSFUL INDUCED SPAWNING AND REARING OF THE HOLOTHURIAN *HOLOTHURIA (METRIATYLA) SCABRA* JAEGER AT TUTICORIN*

In India holothurians are exploited exclusively for export purpose. From holothurians a product commercially known as *beche-de-mer* is prepared. India at present is earning a foreign exchange equal to Rs. 20 lakhs per annum. Presently the markets in Hong Kong and Singapore offer US $ 20 per kg of *beche-de-mer*. Although the price offered by the importers is very attractive and the process involved in the preparation of the product is very simple and inexpensive, the major constraint for the development of the industry is the shortage of raw materials. On the mainland of India the holothurians are restricted to the Gulf of Mannar and Palk Bay region. At present two species of holothurians viz., *Holothuria (Metriatyla) scabra* and *Holothuria (Theelothuria) spinifera* are exploited commercially and there are evidences of over exploitation of these species. This situation forced the Government of India to impose a ban in 1982 on the export of the processed holothurians of less than 8 cm in size

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* Prepared by D. B. James, M. E. Rajapandian, B. K. Baskar and C. P. Gopinathan, Tuticorin Research Centre of CMFRI, Tuticorin.

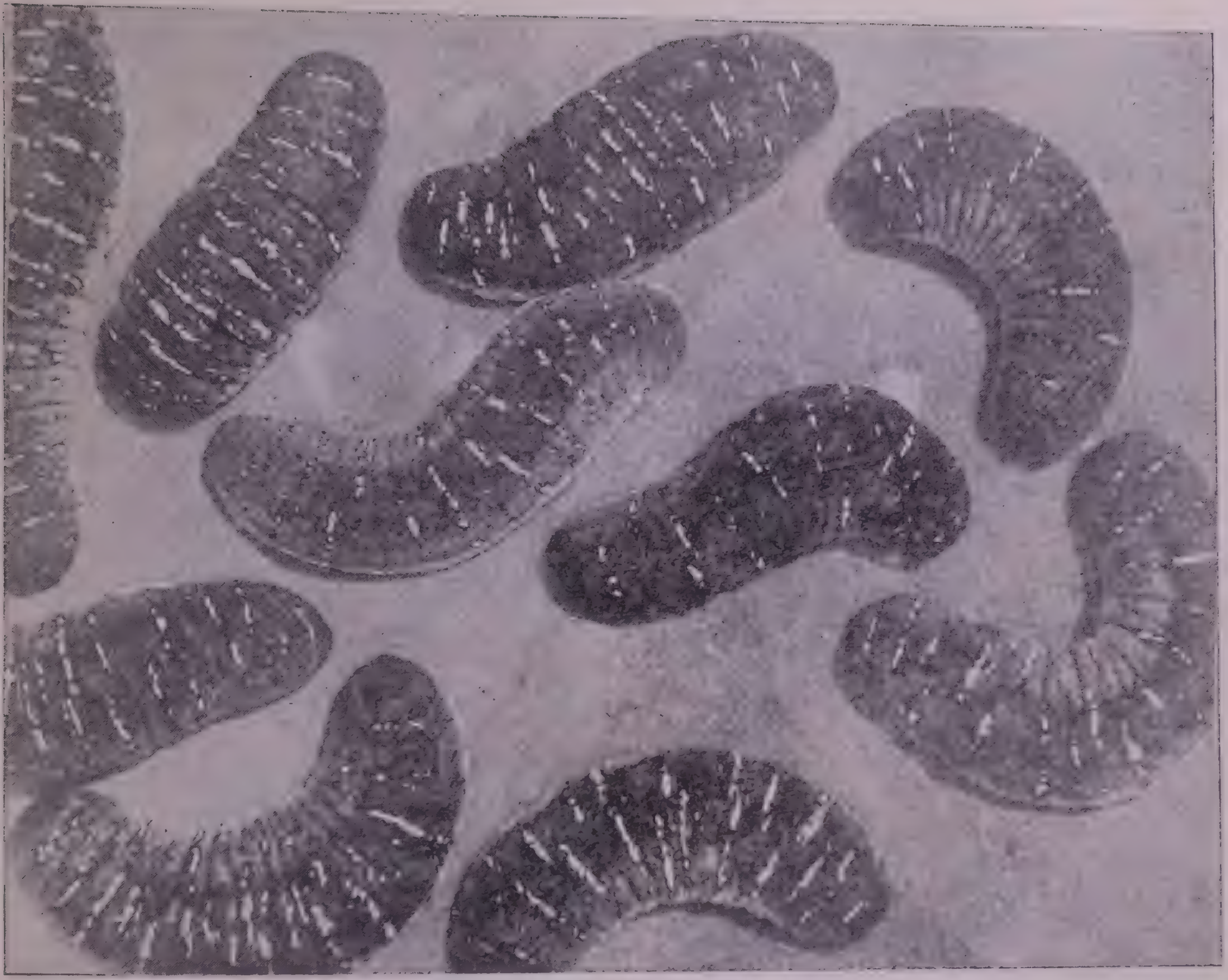

Fig. 1. A group of adult *Holothuria (Metriatyla) scabra*. (*Photo:* Mr. M. Kathirvel)

as a measure of conservation. As a result of this ban the *beche-de-mer* industry is facing a crisis in this country.

At this juncture the Central Marine Fisheries Research Institute, ventured upon a programme on the artificial breeding and production of seed for culture and propagation of the commercially valuable holothurian species. The Institute's success on the above aspects under controlled conditions is significant which may eventually solve the problems presently faced by the *beche-de-mer* industry in India. This is the first time that such work is carried out in India.

Large specimens of *Holothuria (Metriatyla) scabra* (300-350 mm/ 500-600 g) were brought to the laboratory in the last week of January, '88 and they were acclimatised to the laboratory conditions (Fig. 1). Various attempts were made to induce them to spawn in the laboratory such as subjecting them to mild electric shocks, manupulating the salinity and giving injections of radial nerve extracts of the star fish *Pentaceraster regulus*. Finally success was achieved by thermal stimulation.

On 6-2-'88 at 1030 hrs five specimens of *Holothuria (Metriatyla) scabra* were introduced into 70 litres of sea water at 32°C. The normal temperature of sea water in the laboratory was 27°C under which 10 specimens were maintained as control. Another lot of five specimens were put in sea water at 37°C. After ninety minutes one male in the first lot liberated the sperms in the form of white threads which later got mixed with the sea water. This male was immediately removed and placed in normal sea water to allow it to continue spawning. Simultaneously another male

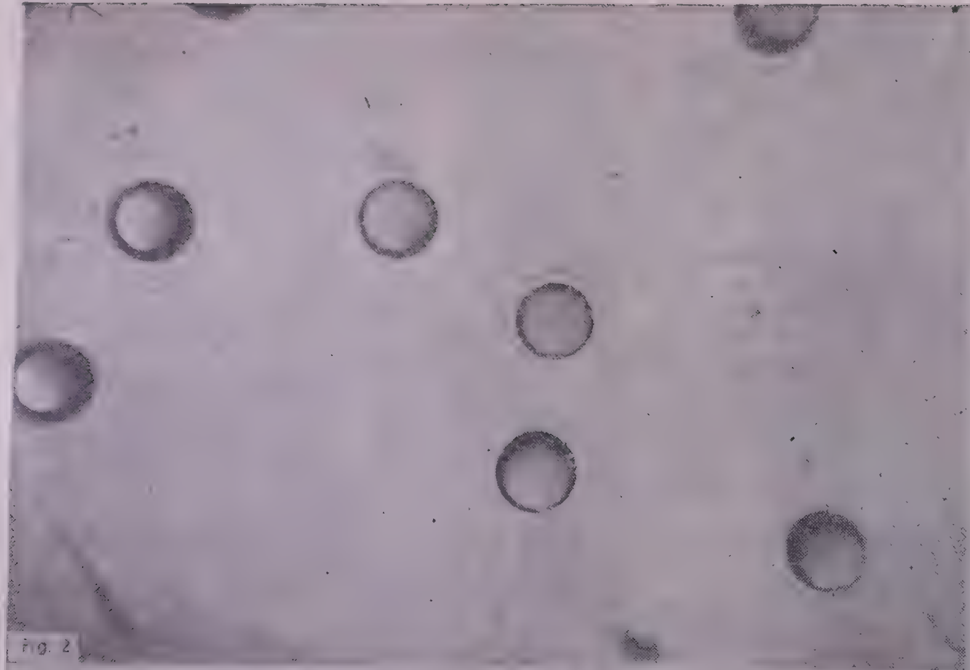

Fig. 2

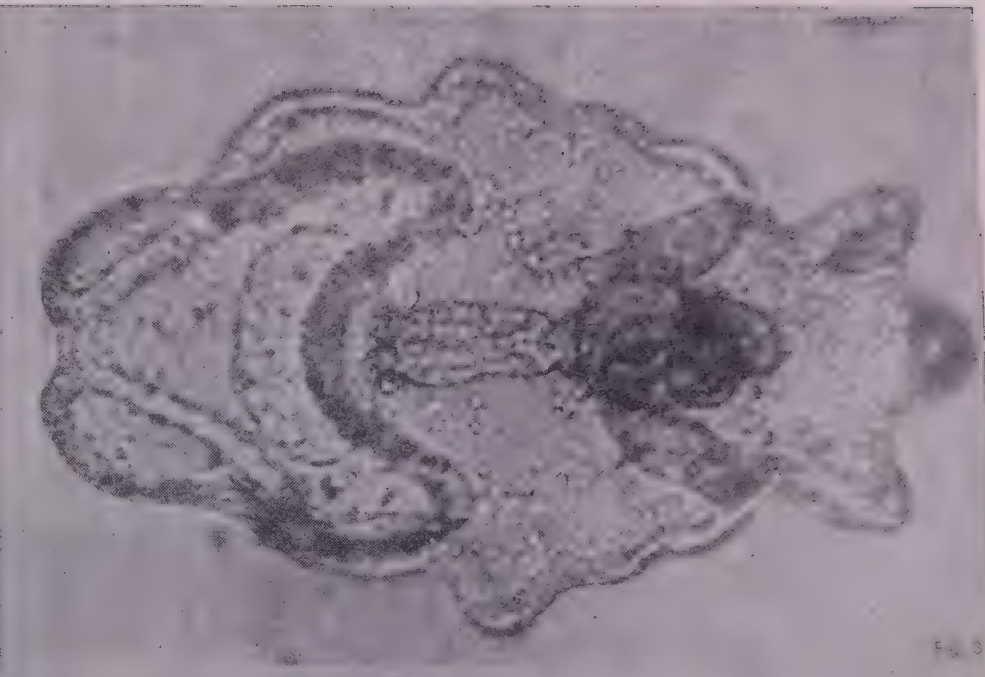

Fig. 3

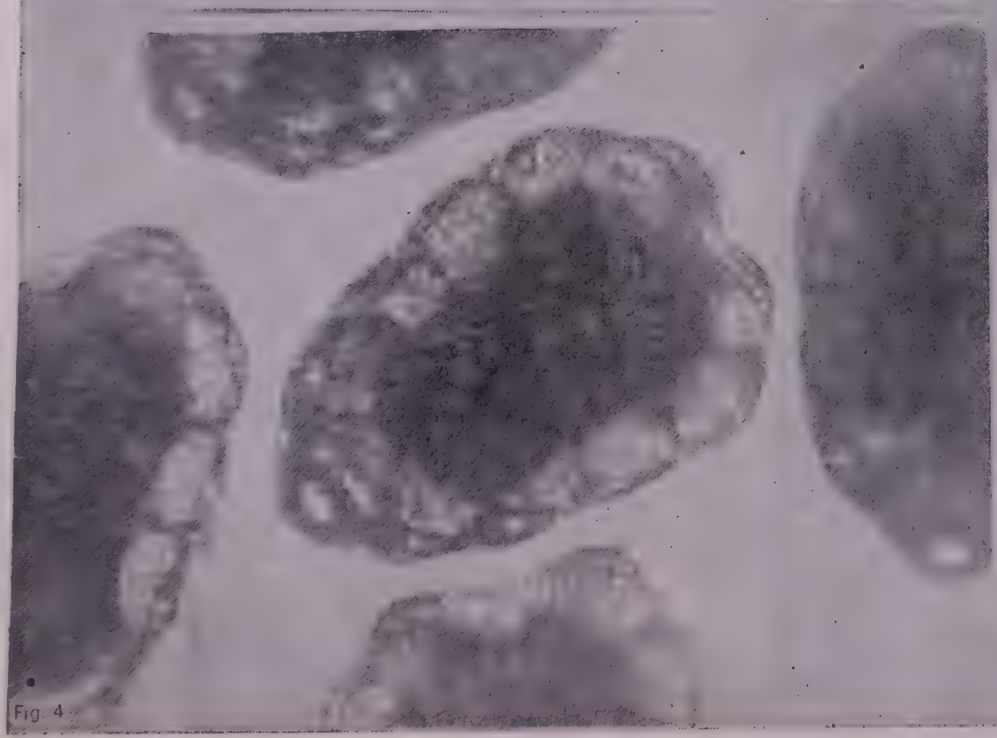

Fig. 4

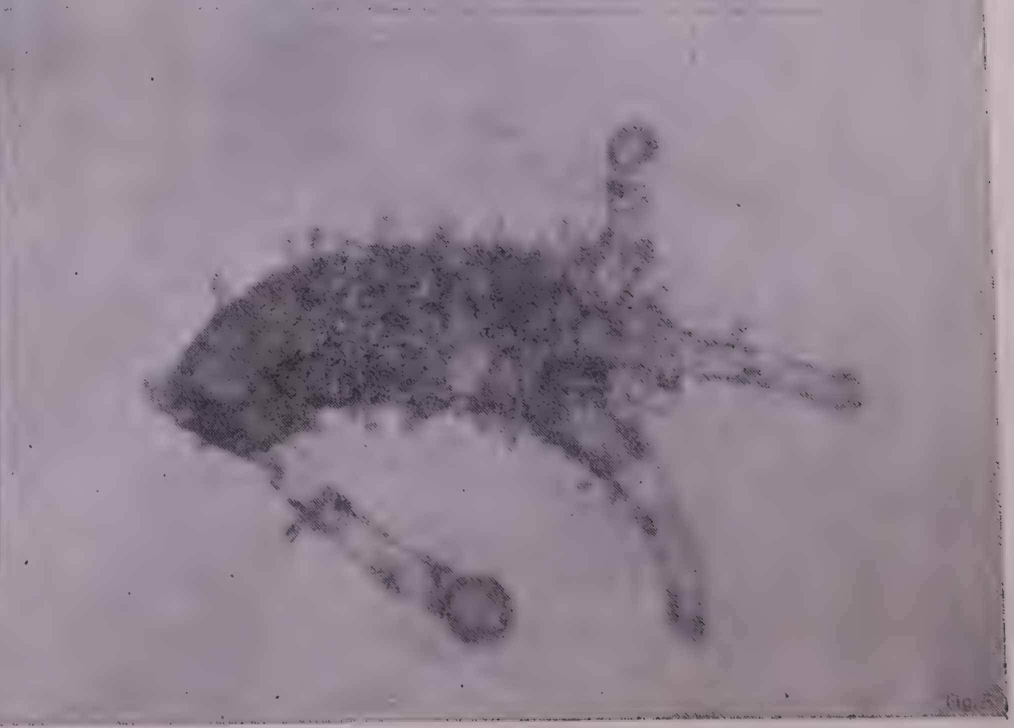

Fig. 5

Fig. 2. A group of eggs.
Fig. 4. Doliolaria larva.

Fig. 3. Auricularia larva.
Fig. 5. Pentactula larva.
(*Photographs by:* Mr. M. E. Rajapandian)

under 37°C spawned and this was also put in normal sea water separately. Both the specimens continued to spawn for 15–20 minutes. On completon of spawning the sperm suspension was transferred to a beaker and the same was poured into a tank with sea water of normal temperature. Into this tank the remaining eight specimens were introduced. The sperms induced a female to spawn in a few spurts. The eggs (Fig. 2) were spherical, white and visible to the naked eye and were found floating. The diameter of the eggs varied from 180–200 μ. The number of eggs was estimated at nine lakhs.

After fertilization the eggs underwent cleavage and were transformed into Dipleurula stage which ranged in length from 190–256 μ. The Dipleurula transformed into Auricularia larvae after 24 hours (Fig. 3). They measured 430 μ in length and 280 μ in breadth. The Auricularia were fed on *Isochrysis galbana* and mixed culture dominated by species of diatoms of *Chaetoceros* and *Skeletonema*. The Auricularia larvae actively fed on *Isochrysis galbana*. The mouth region exhibited constant pulsating movements and the yellowish-green concentration of *Isochrysis* in the stomach was seen in circular movement. As days passed on, the Auricularia larvae became more transparent and the lateral projections also became more prominent. On each side there were four lateral projections and at the tip of each projection there was a round structure. The bands also showed a number of pigment spots. The length of the Auricularia larvae at this stage varied from 660 to 1050 μ (average 860μ) and breadth 240–690 μ (average 500 μ). Some of the Auricularia were smaller in size. A few Auricularia transformed into Doliolaria stage (Fig. 4) on the tenth day. The Doliolaria were barrel-shaped with five bands and with two tentacles projecting out. The posterior portion was slightly tapering. On each side there were five round structures with ossicle distinct at the posterior end. There were five groups of cilia like structures on each side. The Doliolaria moved fast in the forward direction. Their length varied from 420–570 μ (average 485μ) and 240 to 390 μ in breadth (average 295 μ).

On the thirteenth day some of the Doliolaria transformed into Pentactula stage (Fig. 5). The body of Pentactula was tubular with five tentacles at the anterior end and with one short stumpy tube-foot at the posterior end. The cloacal opening was distinct. Colour was greenish brown. The length varied from 330 to 750 μ (average 474μ) and breadth from 250 to 400μ (average 307μ). By eighteenth day the tube-feet and tentacles became more distinct and a number of tables were seen in the skin. The tentacles had a web in between them. At the posterior end two long tube-feet were seen. The spires of the tables were projecting out of the skin. The tentacles and tube-feet also had tables sparcely distributed. The length of the specimens varied from 550 to 720 μ (average 656 μ) and breadth varied from 210 to 320 μ (average 262 μ). The Pentactula have the habit of moving to the edge of the tank and remaining just below the surface of water. Soon they settled down to the bottom and started feeding on powdered *Ulva* and *Sargassum*.

The early development of fertilized egg took place on the surface and column of water. From the Dipleurula stage the larvae started feeding on micro-algal cultures. The Auricularia and Doliolaria are planktonic but the Pentactula settles down to the bottom of the tank. The larvae were reared in one tonne tank in filtered and aerated sea water of salinity 32–34‰ and temperature 27–29°C. Water was changed every day. The temperature, pH and salinity were regularly monitored.

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MARINE FISHERIES INFORMATION SERVICE

8/9/89

No. 88
OCTOBER 1988

Technical and Extension Series

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
COCHIN, INDIA

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

THE MARINE FISHERIES INFORMATION SERVICE: Technical and Extension Series envisages the rapid dissemination of information on marine and brackish water fishery resources and allied data available with the National Marine Living Resources Data Centre (NMLRDC) and the Research Divisions of the Institute, results of proven researches for transfer of technology to the fish farmers and industry and of other relevant information needed for Research and Development efforts in the marine fisheries sector.

Abbreviation – *Mar. Fish. Infor. Serv., T & E Ser.*, No. **88**: 1988

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3. On five whale sharks landed along the Trivandrum-Kanyakumari coast
4. Record catch of tiger sharks from Maharashtra coast
5. Report on two dolphins washed ashore near Mandapam

Front cover photo:

Purse-seine catch of sharks.

Back cover photo:

Purse-seine catch of cat fish *Tachysurus tenuispinis* with eggs.

MARINE FISH CALENDAR

X. KARWAR*

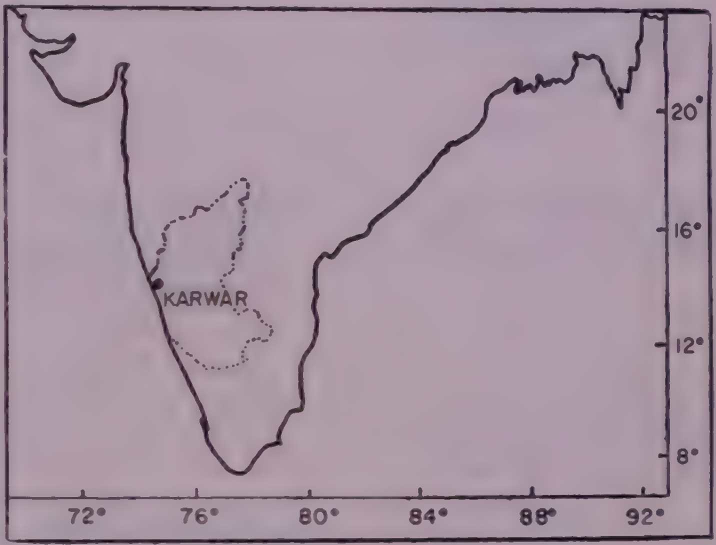
M. H. Dhulkhed and G. G. Annigeri
Karwar Research Centre of CMFRI, Karwar

Introduction

Karwar is situated almost at the northernmost (Lat. 14°50' N and Long. 74°03' E) tip of the Karnataka coast. It is the district headquarters of Uttar Kannada. The coastline extending from Majali in the north to Kasaragod in the south was once famous for *rampan* (shore seine) fishing till the advent of this decade. This part of the coast was called the 'mackerel coast'. However, with the introduction of purse seiners in the mid-seventies and the rapid increase in the strength of this fleet, the indigenous gear *rampan* gradually lost its glory and is plying into oblivion. Similarly various types of gill net, used mostly for catching the oil sardine, mackerel and seer fishes and cast net for soles and prawns have completely disappeared from this coast. Furthermore, the coast has also lost the fame for its mackerel fishery.

Normally the fishing activities are resumed by the beginning of September after the cessation of the south-west monsoon. The period from September to December is very productive when large quantities of oil sardine, lesser sardines comprising *Sardinella fimbriata, S. albella, S. gibbosa* and *S. dayi,* anchovies, mackerel, tunas *(Euthynnus affinis, Auxis thazard, A. rochei)*, black pomfret, carangids, cat fish *(Tachysurus tenuispinis, T. serratus)* and silver bellies are landed. The period from January to May is known for moderate catches of the above groups.

Oil sardine is caught in plenty in most of the months of the fishing season and mackerel and lesser sardines to a lesser extent. Tunas generally appear in the seiners from September to December and again in small quantities from March to May. Bumper catches of cat fishes and pomfrets, especially the black species are hauled up during September and October causing on many–an–occasion the glut condition. Other fishes are landed throughout the fishing season in varying proportions.



The fishing in the Karwar area is based by and large on the purse seiners. As such the fish calendar is prepared on the fish landings of this gear only and the data covered is from 1981 through 1985.

BELONIDAE

Popular English Name : Gar fish/Needle fish
Vernacular Name (Kannada) : 'Kande'/'Havu meenu'
Annual average catch : 2.4 t
Percentage in total catch : 0.03
Fishing methods and their contribution : Purse seine/Trawl net/Gill net/Yendi: —

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* Consolidated by N. Gopinatha Menon and K. Balachandran, CMFRI, Cochin.

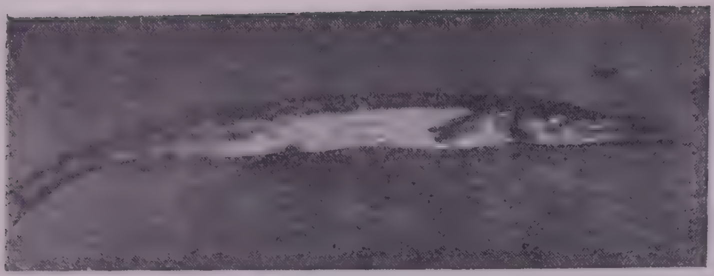

Fig. 1. *Strongylura strongylura.*

Scientific Name	:	*Strongylura strongylura*
Vernacular Name	:	'Kande tole'
Gear	:	Purse seine/Trawl net/ Yendi
Peak period of occurrence	:	Aug. – Dec.
Depth of occurrence	:	5 – 25 m
Length range in commercial fishery	:	100 – 1,000 mm
Size at first maturity	:	—
Spawning season	:	—

CARANGIDAE

Popular English Name	:	Scads/Travellies
Vernacular Name (Kannada)	:	'Kokkare'/'Thonke'/ 'Chorubangude'/ 'Diana'/'Halge meenu'/'Thickli'
Annual average catch	:	600.5 t
Percentage in total catch	:	8.1
Fishing methods and their contribution	:	Purse seine/Trawl net/Yendi/Gill net: —

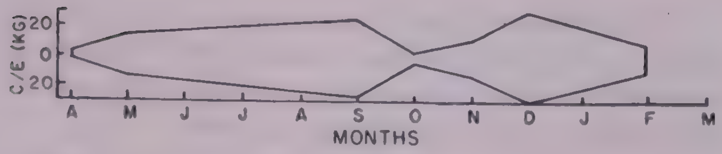

Fig. 2. Seasonal abundance of carangids at Karwar.

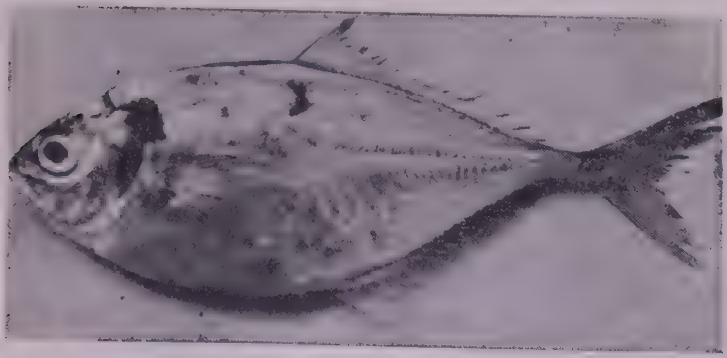

Fig. 3. *Caranx kalla.*

Scientific Name	:	*Caranx kalla*
Vernacular Name	:	'Kokkare'
Gear	:	Purse seine/Trawl net/Yendi/Gill net
Peak period of occurrence	:	Aug. – May
Depth of occurrence	:	2 – 10 m
Length range in commercial fishery	:	50 – 200 mm
Size at first maturity	:	—
Spawning season	:	—

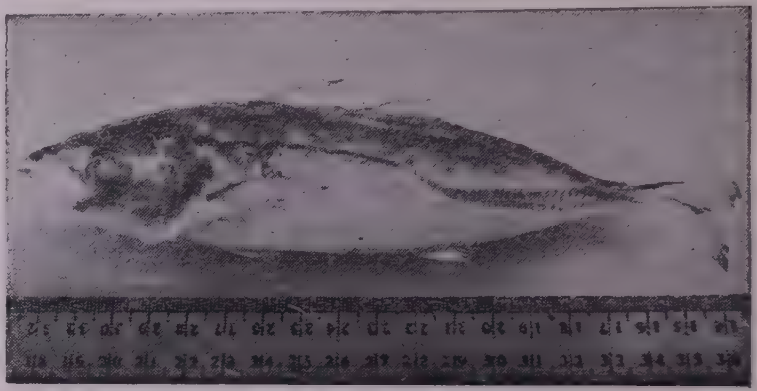

Fig. 4. *Decapterus russelli.*

Scientific Name	:	*Decapterus russelli*
Vernacular Name	:	'Thonke'
Gear	:	Purse seine
Peak period of occurrence	:	Sep. – Apr.
Depth of occurrence	:	5 - 50 m
Length range in commercial fishery	:	70 – 200 mm
Size at first maturity	:	—
Spawning season	:	—

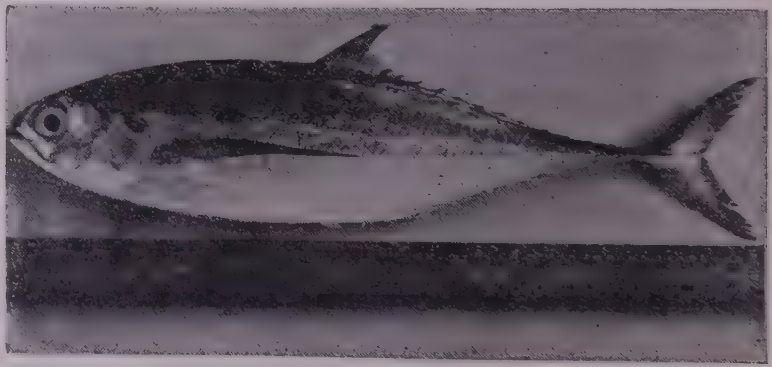

Fig. 5. *Megalaspis cordyla.*

Scientific Name	:	*Megalaspis cordyla*
Vernacular Name	:	'Chorubangude'
Gear	:	Purse seine
Peak period of occurrence	:	Sep. – Apr.
Depth of occurrence	:	5 – 50 m

Length range in commercial fishery : 100 - 300 mm
Size at first maturity : —
Spawning season : —

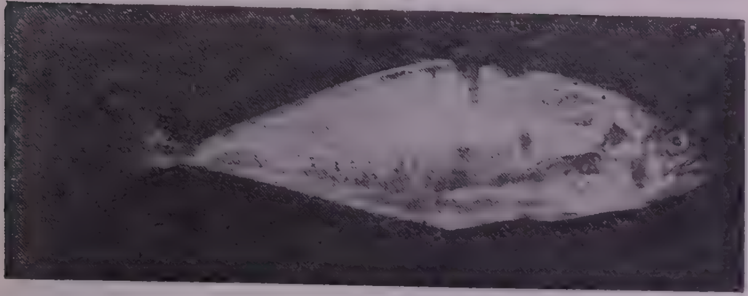

Fig. 6. *Chorinemus tala.*

Scientific Name : *Chorinemus tala*
Vernacular Name : 'Halge meenu'
Gear : Purse seine
Peak period of occurrence : Sep. - Apr.
Depth of occurrence : 5 - 50 m
Length range in commercial fishery : 125 - 250 mm
Size at first maturity : —
Spawning season : —

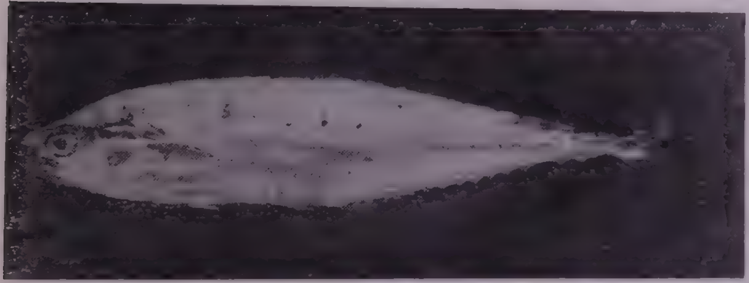

Fig. 7. *Chorinemus tol.*

Scientific Name : *Chorinemus tol*
Vernacular Name : 'Thickli'
Gear : Purse seine
Peak period of occurrence : Sep. - Apr.
Depth of occurrence : 5 - 50 m
Length range in commercial fishery : 200-350 mm
Size at first maturity : —
Spawning season : —

CARCHARHINIDAE

Popular English Name : Sharks
Vernacular Name (Kannada) : 'Sorrah'
Annual average catch : 2.7 t
Percentage in total catch : 0.04
Fishing methods and their contribution : Purse seine/Trawl net/Yendi/Gill net:—

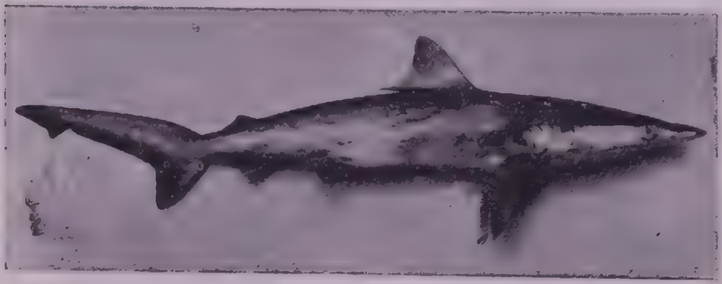

Fig. 8. *Carcharhinus melanopterus.*

Scientific Name : *Carcharhinus melanopterus*
Vernacular Name : 'Sorrah'
Gear : Purse seine/Trawl net/Yendi/Gill net
Peak period of occurrence : Aug. - May
Depth of occurrence : 5 - 50 m
Length range in commercial fishery : 200 - 1,000 mm
Size at first maturity : —
Spawning season : —

CHIROCENTRIDAE

Popular English Name : Wolf herrings
Vernacular Name (Kannada) : 'Karli'
Annual average catch : —
Percentage in total catch : —
Fishing methods and their contribution : Purse seine/Trawl net/Gill net/Yendi: —

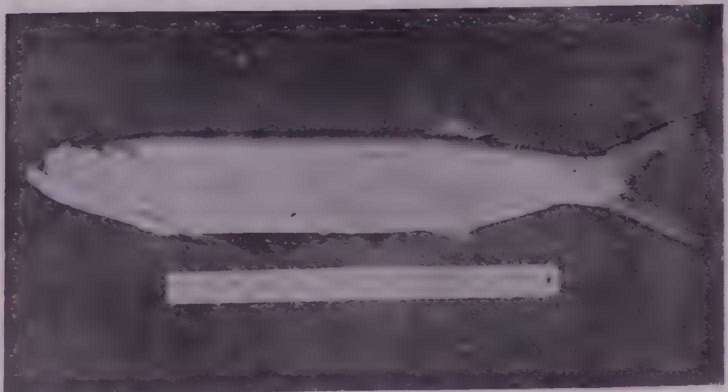

Fig. 9. *Chirocentrus dorab.*

Scientific Name : *Chirocentrus dorab*
Vernacular Name : 'Karli'

Gear : Purse seine/Trawl net/Gill net/Yendi
Peak period of occurrence : Aug. – May
Depth of occurrence : —
Length range in commercial fishery : 200 – 1,000 mm
Size at first maturity : —
Spawning season : ––

CLUPEIDAE

Popular English Name : Sardines/Hilsa/Shads
Vernacular Name (Kannada) : 'Buthayee'/'Tarli'/'Pedi'/'Belenji'/'Palasa'/'Pachki'
Annual average catch : 32,442 t
Percentage in total catch : 60.0
Fishing methods and their contribution : Purse seine/Cast net/Shore seine/Gill net/Yendi: —

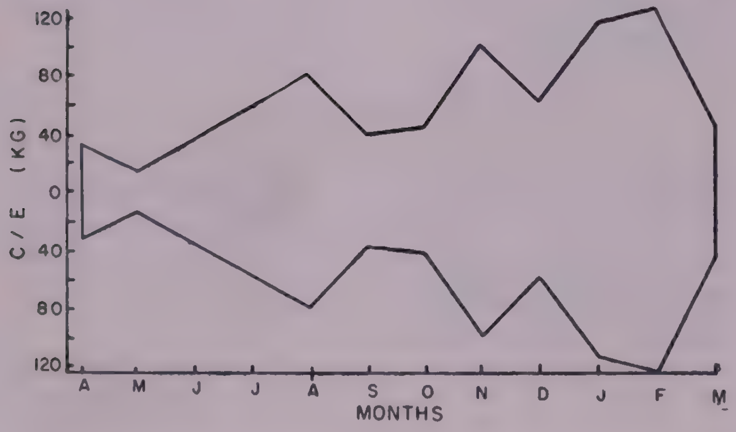

Fig. 10. Seasonal abundance of oil sardine at Karwar.

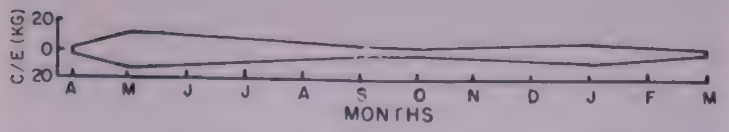

Fig. 11. Seasonal abundance of white sardine (*Escualosa thoracata*) at Karwar.

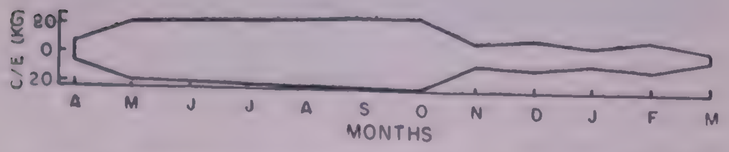

Fig. 12. Seasonal abundance of lesser sardines at Karwar.

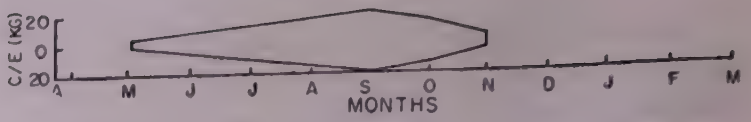

Fig. 13. Seasonal abundance of other clupeids.

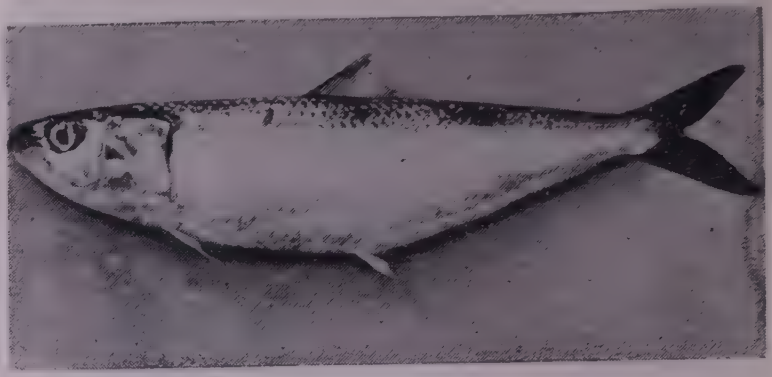

Fig. 14. *Sardinella longiceps.*

Scientific Name : *Sardinella longiceps*
Vernacular Name : 'Buthayee'/'Tarli'
Gear : Purse seine/Cast net/Shore seine/Gill net
Peak period of occurrence : Aug. – May
Depth of occurrence : 11 – 19 m
Length range in commercial fishery : 50 – 220 mm
Size at first maturity : 140 – 145 mm
Spawning season : Jun. – Dec.

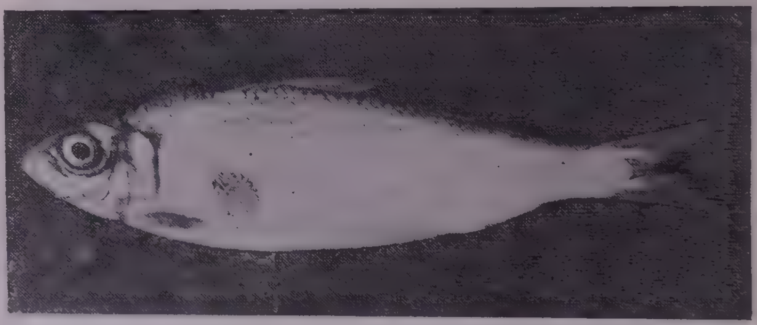

Fig. 15. *Sardinella fimbriata.*

Scientific Name : *Sardinella fimbriata*
Vernacular Name : 'Pedi'
Gear : Purse seine/Cast net/Shore seine/Gill net
Peak period of occurrence : Aug. – May
Depth of occurrence : 11 - 19 m
Length range in commercial fishery : 60 – 205 mm
Size at first maturity : —
Spawning season : —

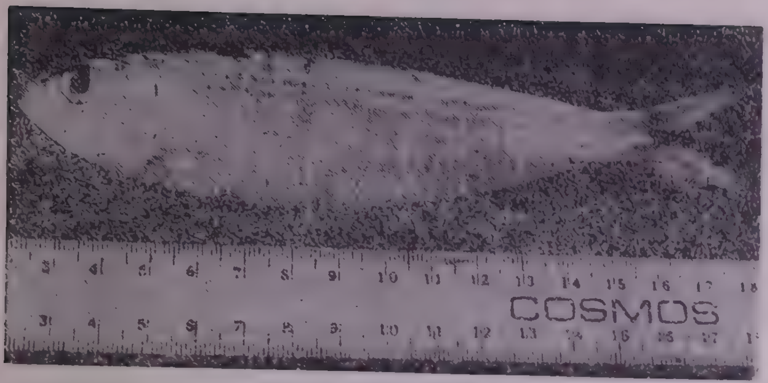

Fig. 16. *Sardinella gibbosa.*

Scientific Name : *Sardinella gibbosa*
Vernacular Name : 'Pedi'
Gear : Purse seine/Cast net/Shore seine/Gill net
Peak period of occurrence : Aug. – May
Depth of occurrence : 11 – 19 m
Length range in commercial fishery : 45 – 200 mm
Size at first maturity : —
Spawning season : —

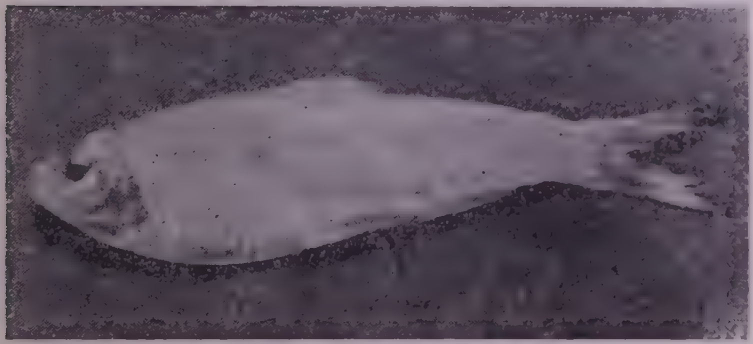

Fig. 17. *Escualosa thoracata.*

Scientific Name : *Escualosa thoracata*
Vernacular Name : 'Belenji'
Gear : Purse seine/Yendi/Gill net/Cast net
Peak period of occurrence : Oct. – May
Depth of occurrence : 11 – 19 m
Length range in commercial fishery : 60 – 175 mm
Size at first maturity : —
Spawning season : —

CORYPHAENIDAE

Popular English Name : Dolphin fish
Vernacular Name (Kannada) : 'Halge meenu'
Annual average catch : 13.7 t
Percentage in total catch : 0.19
Fishing methods and their contribution : Purse seine/Gill net: —

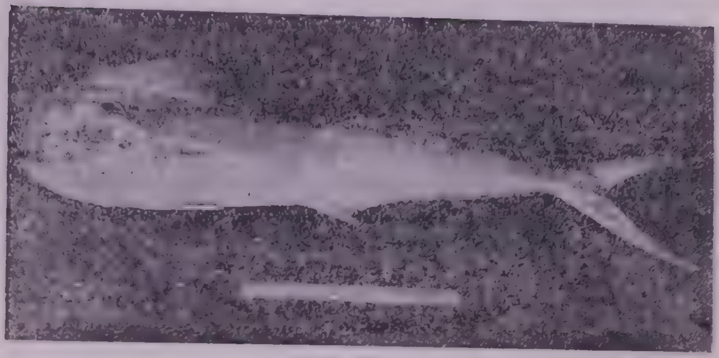

Fig. 18. *Coryphaena hippurus.*

Scientific Name : *Coryphaena hippurus*
Vernacular Name : 'Halge meenu'
Gear : Purse seine/Gill net
Peak period of occurrence : Sep. – Apr.
Depth of occurrence : 5 – 50 m
Length range in commercial fishery : 210 – 460 mm
Size at first maturity : —
Spawning season : —

CYNOGLOSSIDAE

Popular English Name : Tongue sole
Vernacular Name (Kannada) : 'Lepe'
Annual average catch : —
Percentage in total catch : —
Fishing methods and their contribution : Trawl net/Yendi: —

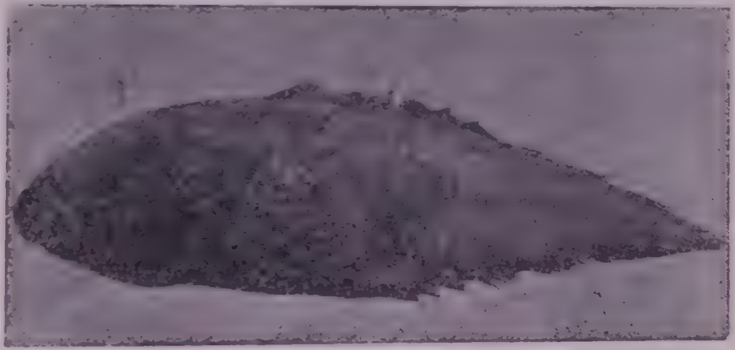

Fig. 19. *Cynoglossus bilineatus.*

Scientific Name : *Cynoglossus bilineatus*
Vernacular Name : 'Lepe'
Gear : Trawl net/Yendi
Peak period of occurrence : Aug. – May
Depth of occurrence : 5 – 50 m
Length range in commercial fishery : 90 – 150 mm

Size at first maturity : —
Spawning season : —

DUSSUMIERIDAE

Popular English Name : Rainbow sardine
Vernacular Name (Kannada) : 'Thirugani'
Annual average catch : 77.3 t
Percentage in total catch : 1.04
Fishing methods and their contribution : Purse seine/Yendi: —

ENGRAULIDAE

Popular English Name : Anchovies
Vernacular Name (Kannada) : 'Dinasi'/'Othaly'/'Enaga'
Annual average catch : 345.8 t
Percentage in total catch : 4.7
Fishing methods and their contribution : Purse seine/Yendi/Trawl net: —

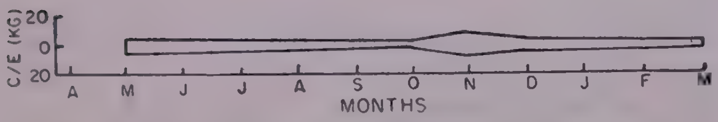

Fig. 20. Seasonal abundance of anchovies at Karwar.

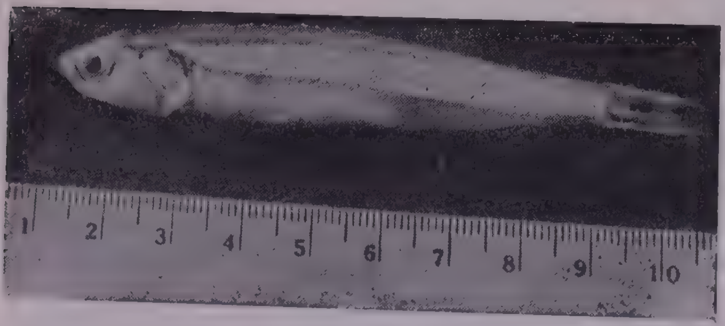

Fig. 21. *Stolephorus devisi.*

Scientific Name : *Stolephorus devisi*
Vernacular Name : 'Dinasi'
Gear : Purse seine/Yendi
Peak period of occurrence : Oct. – May
Depth of occurrence : 11 – 19 m
Length range in commercial fishery : 60 – 115 mm
Size at first maturity : —
Spawning season : —

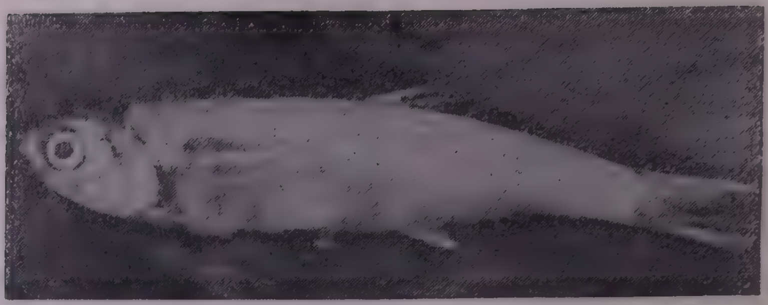

Fig. 22. *Stolephorus bataviensis.*

Scientific Name : *Stolephorus bataviensis*
Vernacular Name : 'Dinasi'
Gear : Purse seine/Yendi
Peak period of occurrence : Oct. – May
Depth of occurrence : 11 – 19 m
Length range in commercial fishery : 60 – 115 mm
Size at first maturity : —
Spawning season : —

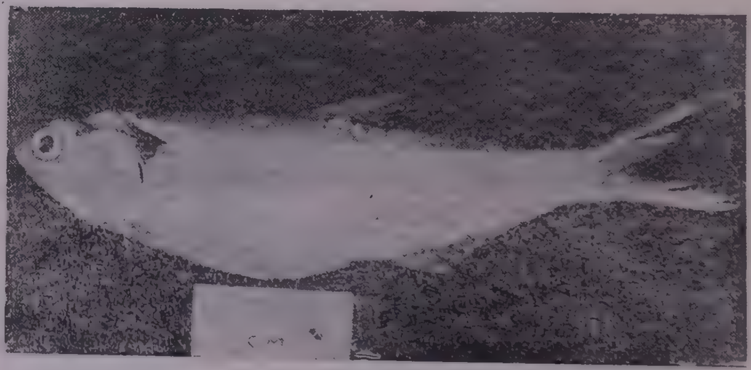

Fig. 23. *Thryssa mystax.*

Scientific Name : *Thryssa mystax*
Vernacular Name : 'Othaly'/'Enaga'
Gear : Purse seine/Trawl net/Yendi
Peak period of occurrence : Sep. – Apr.
Depth of occurrence : 11 – 19 m
Length range in commercial fishery : 80 – 190 mm
Size at first maturity : —
Spawning season : —

LACTARIIDAE

Popular English Name : Big-jawed jumper
Vernacular Name (Kannada) : 'Adabanaga'
Annual average catch : —
Percentage in total catch : —

Fishing methods and their contribution	:	Purse seine/Trawl net/Yendi/Gill net/Cast net: —

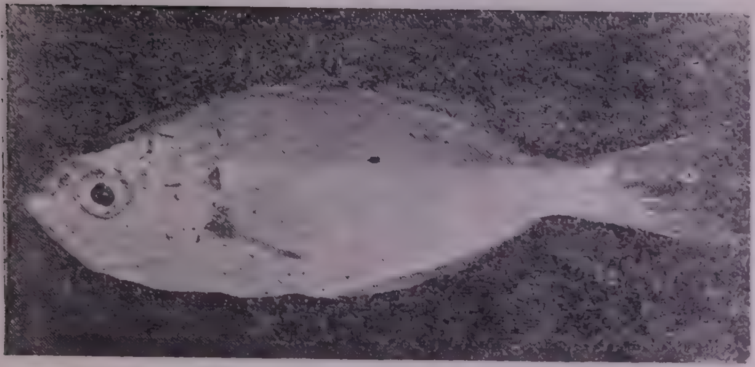

Fig. 24. *Lactarius lactarius.*

Scientific Name	:	*Lactarius lactarius*
Vernacular Name	:	'Adabanaga'
Gear	:	Purse seine/Trawl net/Yendi/Gill net/ Cast net
Peak period of occurrence	:	Aug. – May
Depth of occurrence	:	2 – 10 m
Length range in commercial fishery	:	60 – 180 mm
Size at first maturity	:	—
Spawning season	:	—

LEIOGNATHIDAE

Popular English Name	:	Pony fish/Silver bellies
Vernacular Name (Kannada)	:	'Guruku'
Annual average catch	:	265.9 t
Percentage in total catch	:	3.58
Fishing methods and their contribution	:	Trawl net/Purse seine/Yendi: —

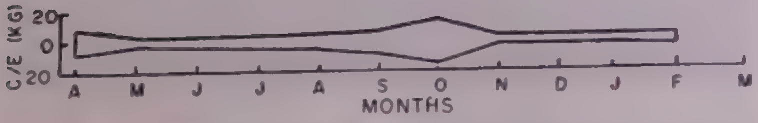

Fig. 25. Seasonal abundance of silver bellies at Karwar.

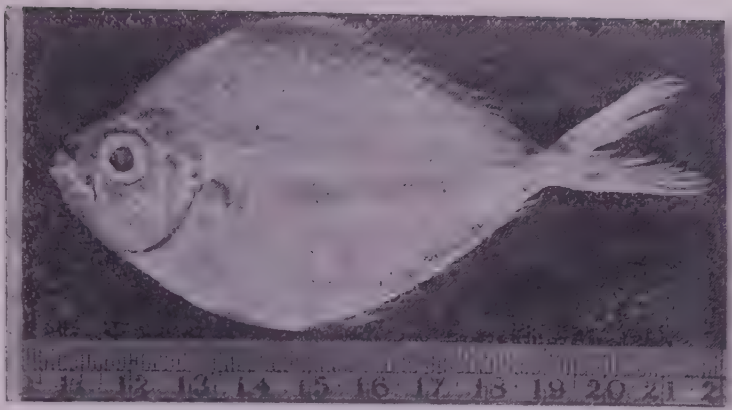

Fig. 26. *Leiognathus bindus.*

Scientific Name	:	*Leiognathus bindus*
Vernacular Name	:	'Guruku'
Gear	:	Purse seine/Trawl net/Yendi
Peak period of occurrence	:	Sep. – Apr.
Depth of occurrence	:	5 – 25 m
Length range in commercial fishery	:	50 – 100 mm
Size at first maturity	:	—
Spawning season	:	—

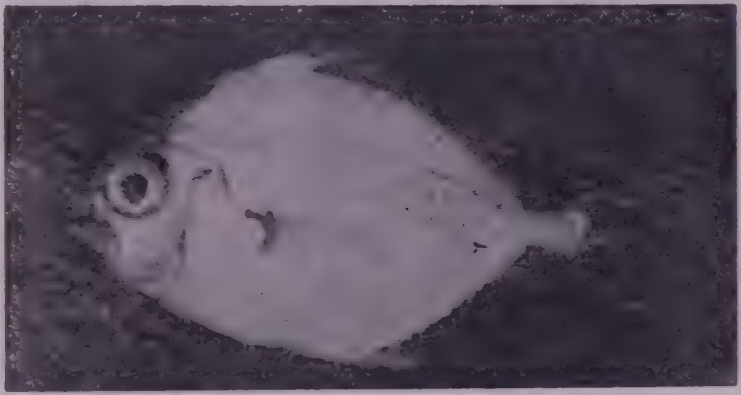

Fig. 27. *Leiognathus splendens.*

Scientific Name	:	*Leiognathus splendens*
Vernacular Name	:	'Guruku'
Gear	:	Trawl net/Purse seine/Yendi
Peak period of occurrence	:	Sep. – Apr.
Depth of occurrence	:	5 – 25 m
Length range in commercial fishery	:	50 – 100 mm
Size at first maturity	:	—
Spawning season	:	—

Mugilidae

Popular English Name : Grey mullet
Vernacular Name (Kannada) : 'Madle'
Annual average catch : —
Percentage in total catch : —
Fishing methods and their contribution : Purse seine/Trawl net/Yendi/Gill net: —

Nemipteridae

Popular English Name : Threadfin bream
Vernacular Name (Kannada) : 'Rane meenu'
Annual average catch : —
Percentage in total catch : —
Fishing methods and their contribution : Purse seine/Trawl net: —

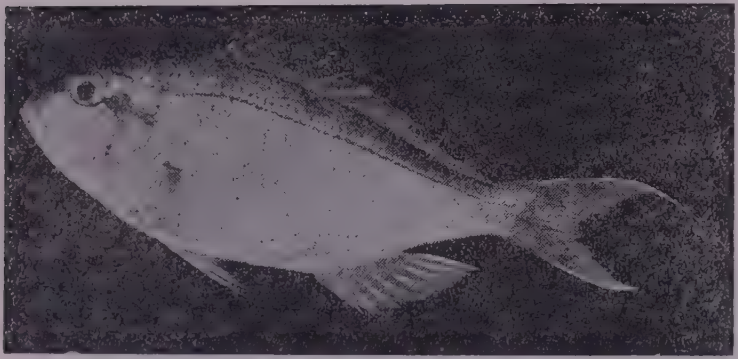

Fig. 28. *Nemipterus japonicus.*

Scientific Name : *Nemipterus japonicus*
Vernacular Name : 'Rane meenu'
Gear : 'Purse seine/Trawl net
Peak period of occurrence : Sep. – Apr.
Depth of occurrence : 5 – 50 m
Length range in commercial fishery : 90 - 180 mm
Size at first maturity : —
Spawning season : —

Platycephalidae

Popular English Name : Flat head
Vernacular Name (Kannada) : 'Vataki'
Annual average catch : —
Percentage in total catch : —
Fishing methods and their contribution : Trawl net/Yendi: —

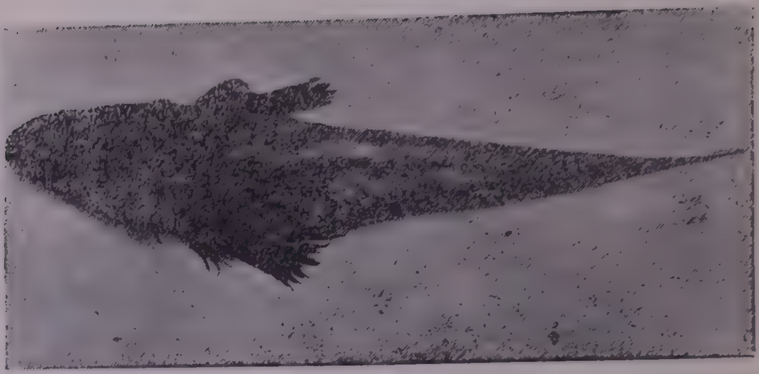

Fig. 29. *Platycephalus scaber.*

Scientific Name : *Platycephalus scaber*
Vernacular Name : 'Vataki'
Gear : Trawl net/Yendi
Peak period of occurrence : Aug. – May
Depth of occurrence : 5 – 50 m
Length range in commercial fishery : 100 – 220 mm
Size at first maturity : —
Spawning season : —

Polynemidae

Popular English Name : Threadfins
Vernacular Name (Kannada) : 'Ravese'
Annual average catch : —
Percentage in total catch : —
Fishing methods and their contribution : Purse seine/Trawl net/Yendi/Gill net: —

Sciaenidae

Popular English Name : Croakers/Jew fish
Vernacular Name (Kannada) : 'Banagu'/'Dodi'
Annual average catch : 17.4 t
Percentage in total catch : 0.23
Fishing methods and their contribution : Purse seine/Trawl net/Gill net/Yendi: —

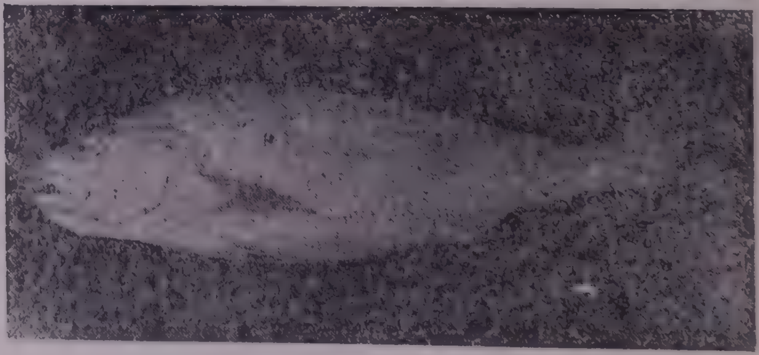

Fig. 30 *Protonibea diacanthus.*

Scientific Name : *Protonibea diacanthus*
Vernacular Name : 'Ghol'
Gear : Purse seine/Gill net
Peak period of occurrence : Aug. – Dec.
Depth of occurrence : 5 – 50 m
Length range in commercial fishery : 200 – 1,500 mm
Size at first maturity : —
Spawning season : —

SCOMBRIDAE

Popular English Name : Mackerel/Tuna/Seer fish
Vernacular Name (Kannada) : 'Bangude'/'Dande'/'Surmai'/'Esoma'/'Bugudi'
Annual average catch : 1,265.2 t
Percentage in total catch : 17.02
Fishing methods and their contribution : Purse seine/Yendi/Gill net : —

TUNA

Popular English Name : Tuna
Vernacular Name (Kannada) : 'Bugudi'
Annual average catch : 145.2 t
Percentage in total catch : 1.97
Fishing methods and their contribution : Purse seine/Gill net: —

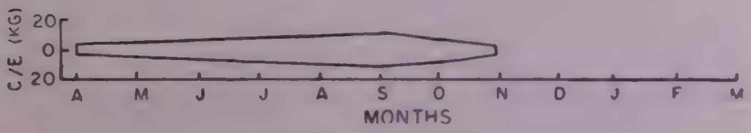

Fig. 31. Seasonal abundance of tunas at Karwar.

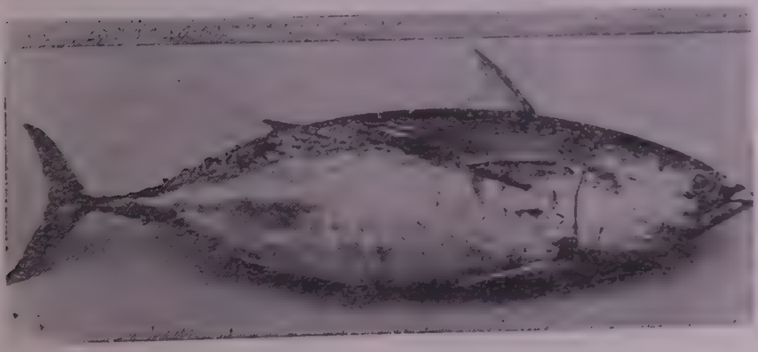

Fig. 32. *Auxis thazard.*

Scientific Name : *Auxis thazard*
Vernacular Name : 'Bugudi'
Gear : Purse seine/Gill net
Peak period of occurrence : Aug. – Dec.
Depth of occurrence : 10 – 75 m
Length range in commercial fishery : 200 – 350 mm
Size at first maturity : —
Spawning season : —

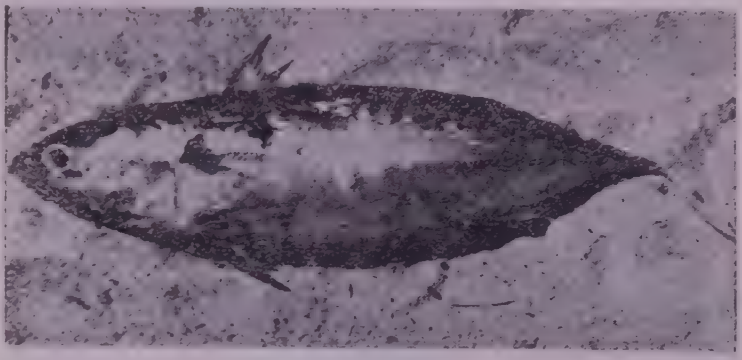

Fig. 33. *Auxis rochei.*

Scientific Name : *Auxis rochei*
Vernacular Name : 'Bugudi'
Gear : Purse seine/Gill net
Peak period of occurrence : Aug. – Dec.
Depth of occurrence : 10 – 75 m
Length range in commercial fishery : 200 – 300 mm
Size at first maturity : —
Spawning season : —

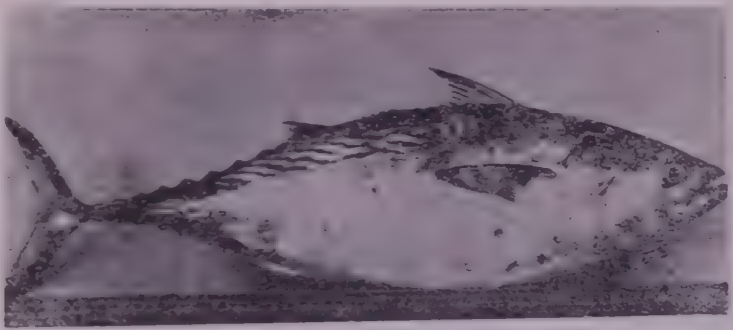

Fig. 34. *Euthynnus affinis.*

Scientific Name : *Euthynnus affinis*
Vernacular Name : 'Bugudi'
Gear : Purse seine/Gill net
Peak period of occurrence : Aug. – May
Depth of occurrence : 5 – 50 m
Length range in commercial fishery : 250 – 680 mm
Size at first maturity : —
Spawning season : —

SEER FISHES

Popular English Name : Seer fish
Vernacular Name (Kannada) : 'Esona'/'Dande'/'Surmai'
Annual average catch : 6.6 t
Percentage in total catch : 0.09
Fishing methods and their contribution : Purse seine/Yendi/Gill net : —

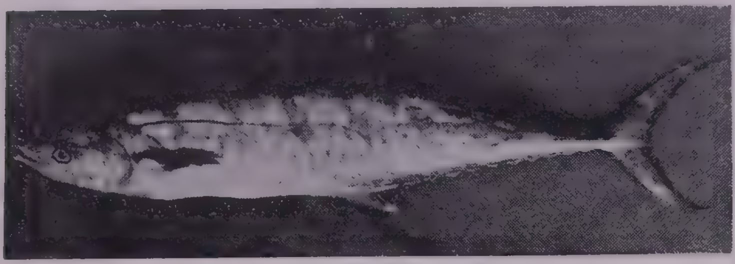

Fig. 35. *Scomberomorus commerson.*

Scientific Name : *Scomberomorus commerson*
Vernacular Name : 'Dandi'
Gear : Purse seine/Gill net/Yendi
Peak period of occurrence : Aug. – May
Depth of occurrence : 10 – 75 m
Length range in commercial fishery : 410 – 770 mm
Size at first maturity : —
Spawning season : —

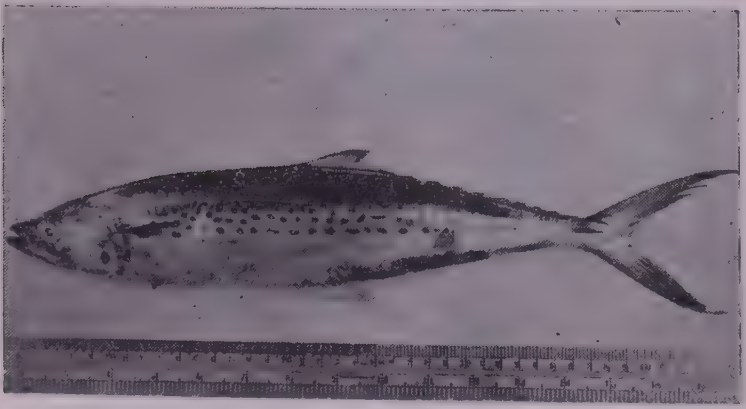

Fig. 36. *Scomberomorus guttatus.*

Scientific Name : *Scomberomorus guttatus*
Vernacular Name : 'Surmai'
Gear : Purse seine/Gill net/Yendi
Peak period of occurrence : Aug. – May
Depth of occurrence : 10 – 75 m
Length range in commercial fishery : 400 – 610 mm
Size at first maturity : —
Spawning season : —

MACKEREL

Popular English Name : Mackerel
Vernacular Name (Kannada) : 'Bangude'
Annual average catch : 1,113.4 t
Percentage in total catch : 14.97
Fishing methods and their contribution : Purse seine/Yendi/Gill net : —

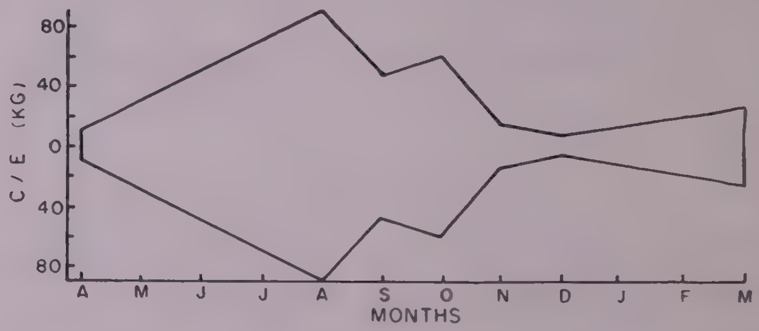

Fig. 37. Seasonal abundance of mackerel at Karwar.

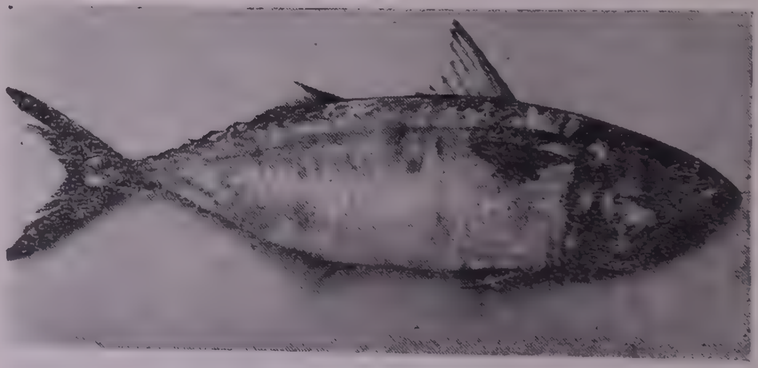

Fig. 38. *Rastrelliger kanagurta*

Scientific Name : *Rastrelliger kanagurta*
Vernacular Name : 'Bangude'
Gear : Purse seine/Yendi/Gill net
Peak period of occurrence : Aug. – May
Depth of occurrence : 2 – 50 m
Length range in commercial fishery : 70 – 270 mm
Size at first maturity : 220 mm
Spawning season : May – Dec.

SPHYRAENIDAE

Popular English Name : Barracuda
Vernacular Name (Kannada) : 'Banse'
Annual average catch : 0.4 t
Percentage in total catch : 0.01
Fishing methods and their contribution : Purse seine/Trawl net/ Yendi: —

STROMATEIDAE

Popular English Name : Pomfrets
Vernacular Name (Kannada) : 'Paplet'/'Manji'/ 'Karimanji'
Annual average catch : 136.5 t
Percentage in total catch : 1.84
Fishing methods and their contribution : Purse seine/Trawl net/ Gill net: —

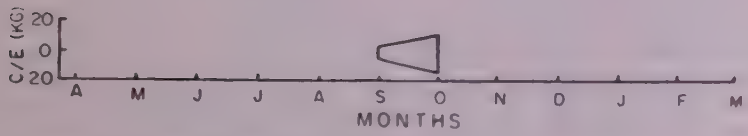

Fig. 39. Seasonal abundance of pomfrets at Karwar.

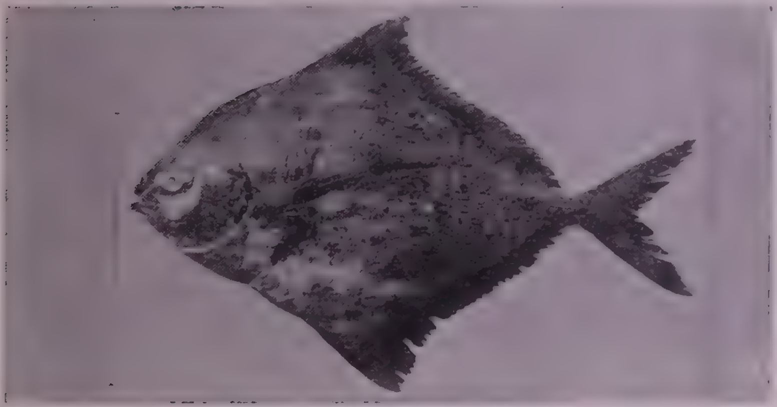

Fig. 40. *Parastromateus niger.*

Scientific Name : *Parastromateus niger*
Vernacular Name : 'Kari manji'
Gear : Purse seine/Gill net
Peak period of occurrence : Sep. – Oct.
Depth of occurrence : 5 – 50 m
Length range in commercial fishery : 50 – 450 mm
Size at first maturity : —
Spawning season : —

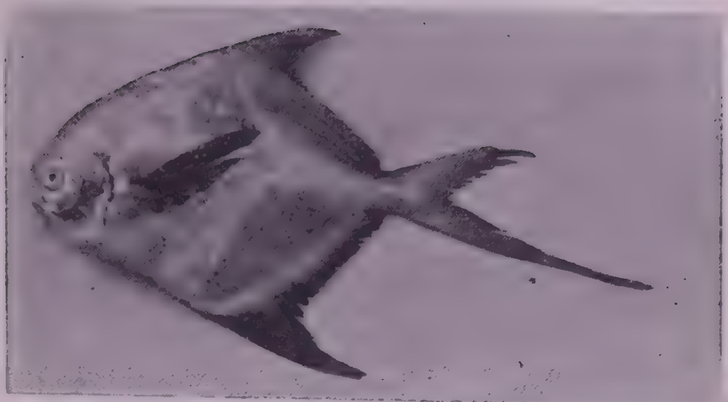

Fig. 41. *Pampus argenteus.*

Scientific Name : *Pampus argenteus*
Vernacular Name : 'Paplet'
Gear : Purse seine/Trawl net/
: Gill net
Peak period of occurrence : Sep. – Oct.
Depth of occurrence : 5 – 50 m
Length range in commercial fishery : 40 – 290 mm
Size at first maturity : —
Spawning season : —

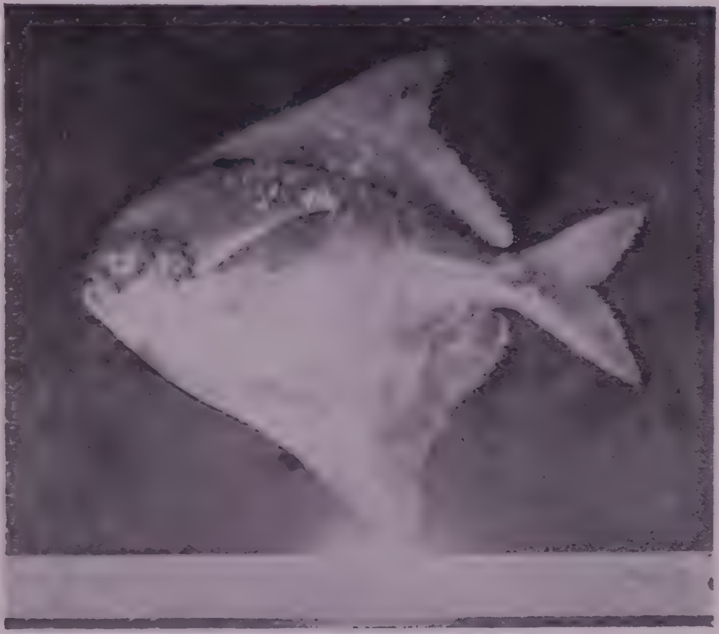

Fig. 42. *Pampus chinensis.*

Scientific Name : *Pampus chinensis*
Vernacular Name : 'Manji'
Gear : Purse seine/Trawl net/ Gill net
Peak period of occurrence : Sep. – Oct.
Depth of occurrence : 5 - 50 m
Length range in commercial fishery : 50 – 250 mm
Size at first maturity : —
Spawning season : —

TACHYSURIDAE

Popular English Name : Cat fish
Vernacular Name (Kannada) : 'Shade'
Annual average catch : 207.0 t
Percentage in total catch : 2.79
Fishing methods and their contribution : Purse seine/Gill net/Trawl net/Yendi: —

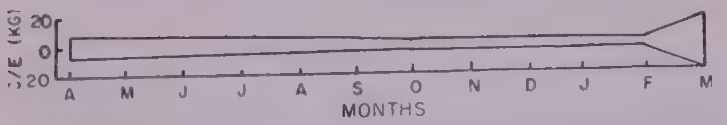

Fig. 43. Seasonal abundance of cat fishes at Karwar.

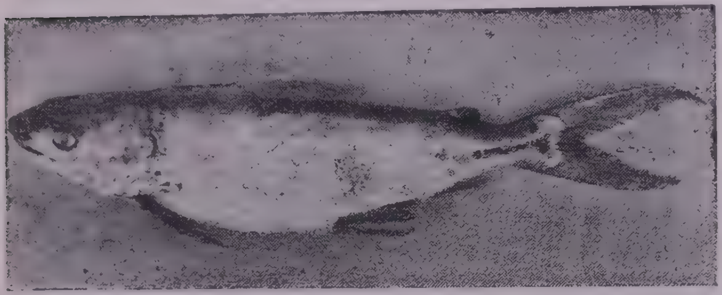

Fig. 44. *Tachysurus thalassinus.*

Scientific Name : *Tachysurus thalassinus*
Vernacular Name : 'Shade'
Gear : Purse seine/Gill net
Peak period of occurrence : Aug. – May
Depth of occurrence : 5 – 25 m
Length range in commercial fishery : 50 – 585 mm
Size at first maturity : —
Spawning season : —

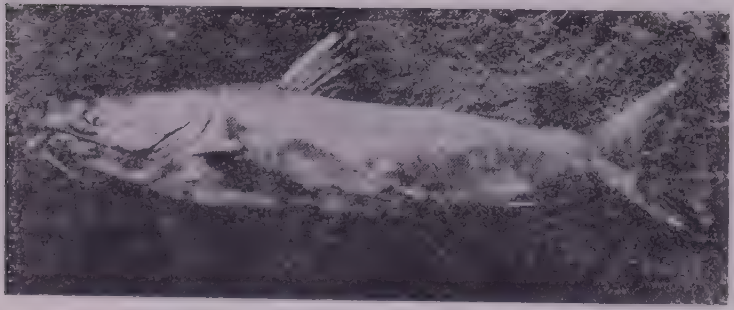

Fig. 45. *Tachysurus tenuispinis.*

Scientific Name : *Tachysurus tenuispinis*
Vernacular Name : 'Shade'
Gear : Purse seine/Trawl net/Yendi/Gill net
Peak period of occurrence : Aug.– Dec.
Depth of occurrence : 5 – 25 m
Length range in commercial fishery : 250 – 400 mm
Size at first maturity : —
Spawning season : —

THERAPONIDAE

Popular English Name : Thorn fish/Crescent perch
Vernacular Name (Kannada) : 'Garagat'
Annual average catch : 5.5 t
Percentage in total catch : 0.07
Fishing methods and their contribution : Purse seine/Trawl net: —

TRICHIURIDAE

Popular English Name : Ribbon fish
Vernacular Name (Kannada) : 'Kambli'
Annual average catch : 16 t
Percentage in total catch : 0.21
Fishing methods and their contribution : Purse seine/Trawl net/Yendi: —

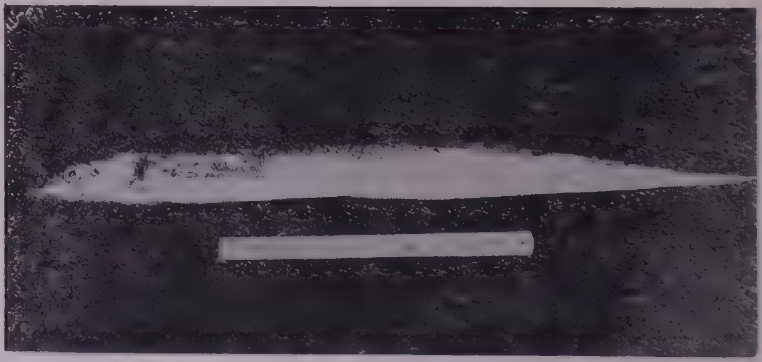

Fig. 46. *Trichiurus lepturus.*

Scientific Name : *Trichiurus lepturus*
Vernacular Name : 'Kambli'
Gear : Purse seine/Trawl net/Yendi
Peak period of occurrence : Aug. – May
Depth of occurrence : 5 – 50 m
Length range in commercial fishery : 150 – 1,500 mm
Size at first maturity : —
Spawning season : —

DASYATIDAE

Popular English Name : Rays
Vernacular Name (Kannada) : 'Thorake'
Annual average catch : 0.5 t
Percentage in total catch : 0.01
Fishing methods and their contribution : Trawl net/Yendi/Gill net: —

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OIL SARDINE, AN EMERGING NEW FISHERY RESOURCE ALONG THE EAST COAST*

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Visakhapatnam Research Centre of CMFRI, Visakhapatnam

The oil sardine *(Sardinella longiceps)* (Fig. 1) is known to occur in the Indian waters from Maharashtra to Orissa. Large schools of the fish are encountered in the inshore waters, sustaining a traditional commercial fishery along the coasts of Kerala and Karnataka. Its occurrence along the east coast was considered to be only sporadic and rare. In recent years, however, there has been an increase in the landings of this species along the east coast. This report gives a brief account of the present status of the oil sardine fishery along the east coast.

Statewise production

Statewise annual landings of the oil sardine for the east coast for a period of 26 years (1961–'86) are given in Table 1. Oil sardine did not find a separate entry into fishery prior to 1961 in the records published on the marine fish production in the east coast states. It may be seen from the Table that along the southern section of the east coast (Tamilnadu including Pondicherry), the oil sardine is being recorded in the fish landings more or less continuously since 1961 with breaks in 1962 and 1974–'76. In Andhra Pradesh oil sardine was recorded only during 1966, 1973–'76 and 1985–'86. Along the Orissa coast, however, the fish was noticed in the landings in two periods; during 1969–'74 (with breaks in 1970 and 1972) and from 1984–'86. Considering the oil sardine landings along the east coast it is seen that the landings were low during the period 1961-'81, ranging from one tonne to 1,011 tonnes with the annual average at 215 tonnes, and relatively high during recent years (1982-'86) ranging from 1,084 to 9,157 tonnes with the annual average at 3,797 tonnes.

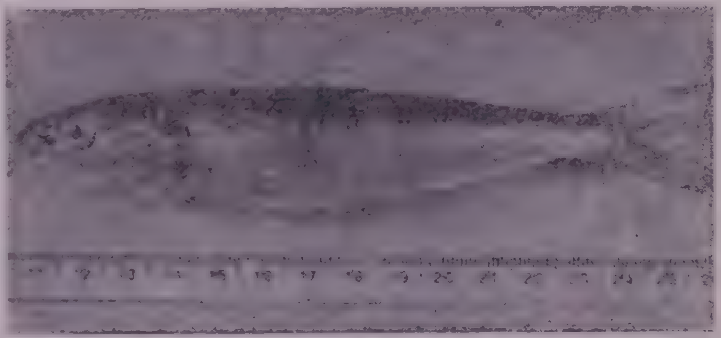

Fig. 1. *Sardinella longiceps*

Thus, in recent years the landings of oil sardine along the east coast have shown a marked increase. Over the 26 year period under consideration, Tamilnadu and Pondicherry together accounted for 85% of the oil sardine catch landed along the east coast followed by Andhra Pradesh 11% and Orissa 4%.

Regional distribution

District-wise landing figures of oil sardine along the east coast states for the period 1983-'86 were examined. In Orissa about 99% of the oil sardine catch was recorded from the southernmost district namely, Ganjam and the rest from Puri and Cuttack in 1984, and none in the northernmost district of Balasore. During 1985 and 1986 the entire catch in Orissa was from Ganjam district. Oil sardine was absent in the

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*Basic data and information were furnished by Sri. P. Sam Bennet for Tuticorin; Shri J. C. Gnanamuthu and Shri P. T. Meenakshisundaram for Cuddalore, Mahabalipuram and Madras; K. Ramasomayajulu, and K. Dhanaraju for around Gopalpur (Ganjam district); Shri S. Satya Rao for Visakhapatnam and Vizianagaram districts; C. V. Sheshagiri Rao for East Godavari district; and Shri G. C. Lakshmiah for Nellore district. Shri M. S. Sumithrudu assisted in the collection of oil sardine samples and analysis of data at Visakhapatnam and Shri K. V. Somasekharan Nair made available a sample of oil sardine from Cochin.

Table 1. *Statewise oil sardine landings (in tonnes) in the east coast during* 1961–'86

Year	Orissa	Andhra Pradesh	Tamilnadu & Pondicherry	Total
1961	—	—	1	1
1962	—	—	—	—
1963	—	—	1	1
1964	—	—	134	134
1965	—	—	32	32
1966	—	61	37	98
1967	—	—	32	32
1968	—	—	412	412
1969	247	—	18	265
1970	—	—	46	46
1971	2	—	45	47
1972	—	—	146	146
1973	38	125	45	208
1974	4	564	—	568
1975	—	131	—	131
1976	—	112	—	112
1977	—	—	714	714
1978	—	—	36	36
1979	—	—	1,011	1,011
1980	—	—	320	320
1981	—	—	195	195
1982	—	—	1,084	1,084
1983	—	—	1,461	1,461
1984	539	—	2,115	2,654
1985	96	263	4,270	4,629
1986	12	1,255	7,890	9,157
Total	938	2,511	20,045	23,494
Percentage	3.99	10.69	85.32	

catches along the Orissa coast during 1983. In Andhra Pradesh oil sardine was recorded from Vizianagaram and Visakhapatnam in the north and from Prakasam and Nellore districts in the south during 1985. But in 1986 the fish was recorded only from Vizianagaram, Visakhapatnam and East Godavari districts. Over the two year period (1985–'86), bulk of the catch was recorded only in Visakhapatnam and East Godavari districts. Only stray specimens were observed in Srikakulam district during March–April, 1986. Earlier, oil sardine was observed in the landings on a single occasion (18–5–1983) at Lawsons Bay, Visakhapatnam. An estimated 765 kg of the fish was caught in a single haul of shore seine. The fish measured 145–165 mm in total length. Thereafter oil sardine was noticed in the inshore catches, only in 1985; in the 1st quarter in Nellore and Prakasam districts, from the 2nd quarter in Visakhapatnam district and from 3rd quarter from Vizianagaram district. In Tamilnadu including Pondicherry the oil sardine catches were mostly obtained from South Arcot district (37%) and Pondicherry (27%) followed by Chingelpattu (18%), Kanyakumari (5%), Tirunelveli, Ramanathapuram and Tanjore districts (each 4%) and Madras (1%). There was no record of the fish from Pudukkottai district during the period 1983-'86.

Seasonal distribution

Quarterwise oil sardine landings, in the east coast states for the different years during 1983-'86 are given in Table 2. During this period the oil sardine first appeared in the landings along Orissa coast in March 1984. Thereafter, the catches improved considerably but declined in 1986. Over the period 1984–'86 oil sardine catches were obtained mostly during the second quarter followed by the third, fourth and first quarters. In Andhra Pradesh, over the period 1985–'86, the bulk of the catch was obtained during the fourth quarter followed by third, together accounting for 88% of the annual landings. Catches during the second quarter were very poor. Along the Tamilnadu–Pondicherry coast also the third and fourth quarters yielded the bulk (80%) of the annual landings during the period 1983–'86. Considering the district-wise landings over the period, either the third or the fourth quarter witnessed the maximum landings in the different districts. However, fairly good catches were obtained during the second quarter in Chingelpattu, Tanjore, Ramanathapuram and Kanyakumari districts, and during both the first and second quarters in Tinneveli district. Thus best catches were witnessed during the third and fourth quarters along the Tamilnadu-Pondicherry-Andhra Pradesh coasts and during the second quarter along the Orissa coast.

Gear and catch per net

Gill nets, boat seines, bag nets, shore seines, drag nets and shrimp trawls landed the oil sardine along the east coast.

In Orissa state bulk of the oil sardine catch was landed by gill net ('Kotla vala') and the rest by shore seine and drag net. Around Gopalpur (Ganjam district) gill nets landed 1-27 kg/net with the average around 14 kg. Boat seines landed 1-120 kg/net, but shore seine landed only stray specimens. Drag nets (with mesh size of 1-2 cm) obtained 5-140 kg of small sized oil sardine per haul during May and July, 1985.

Table 2. *Quarterwise oil sardine landings (in tonnes) in the east coast states during* 1983–'86

Quarter/ year	I	II	III	IV	Total
			Orissa		
1983	—	—	—	—	—
1984	—	535	4	—	539
1985	—	33	47	16	96
1986	5	1	6	—	12
Total	5	569	57	16	647
Percentage	0.77	87.95	8.81	2.47	
			Andhra Pradesh		
1983	—	—	—	—	—
1984	—	—	—	—	—
1985	164	1	18	80	263
1986	2	16	499	738	1,255
Total	166	17	517	818	1,518
Percentage	1.94	1.12	34.06	53.89	
			Tamilnadu & Pondicherry		
1983	156	128	251	926	1,461
1984	627	159	57	1,272	2,115
1985	209	721	1,613	1,727	4,270
1986	909	322	4,366	2,293	7,890
Total	1,901	1,330	6,287	6,218	15,736
Percentage	12.08	8.45	39.95	39.51	

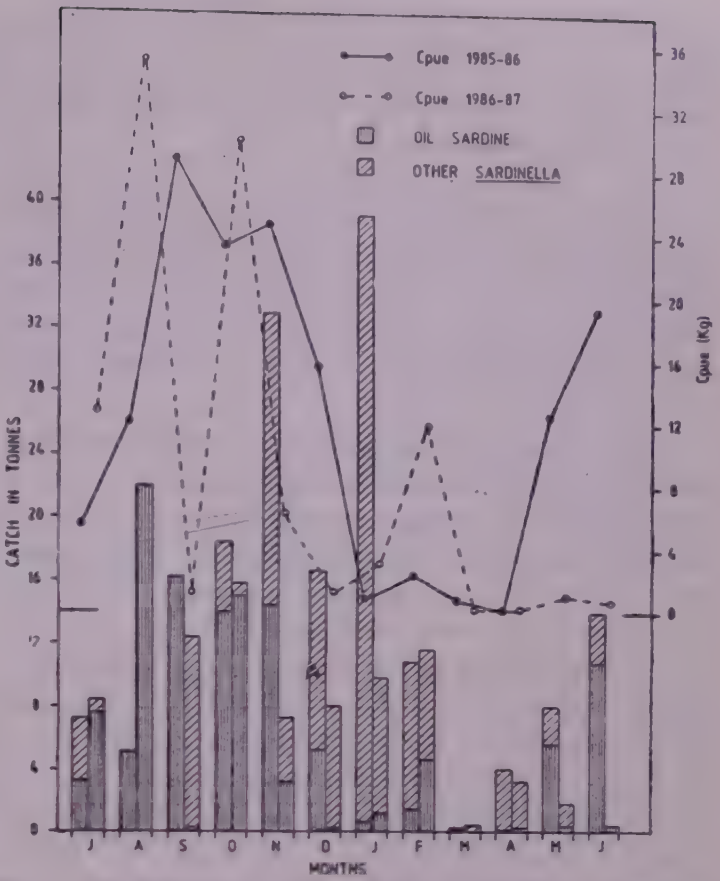

Fig. 2. Monthly trends in the catches of oil sardine *S. longiceps*, and of the other sardines *(S. fimbriata* and *S. gibbosa)* during 1985–'86 (left) and 1986–'87 (right) and CPUE (catch per net per trip) of oil sardine landed by boat seine at Visakhapatnam Outer Harbour.

In Andhra Pradesh bulk of the oil sardine catch was recorded from shore seines ('Alivi vala' and 'Pedda vala') followed by boat seines/bag nets ('Iragavala'), gill nets ('Vaddi vala') and shrimp trawls. However, at the Visakhapatnam Outer Harbour landing centre (Jalaripeta) 99.9% of the oil sardine catch was landed by boat seine ('Iraga vala') and the rest by gill net. Occasionally, oil sardine was also met with in shrimp trawl landings. At Visakhapatnam this fish is being landed regularly by boat seine since July, 1985. Oil sardine was observed in the catches of boat seines operated both within the breakwater area where the depth varies between 15—25 metres and out at sea within 2–3 km from the shore. During July, 1985–June, '87 period, the fish was available in all the months except in March, 1987 (Fig. 2). In boat seines oil sardine catch amounted to 77.1 and 55.7 t forming 45 and 55% of the total sardine catch in the first and second year respectively. Out of the 310 units of boat seines sampled over the two year period, 83% had oil sardine, the catch varying around 0.25 to 100 kg per net. The monthly catch per boat seine ranged from 0.16 to 28.8 kg with the annual average at 12.31 kg during July, 1985-June, 1986 and from 0.29 to 35.15 kg with the average at 8.52 kg during July, 1986-June, 1987. Good catch rates were available during August-December and May–June in the first year and during July, August, October and February in the second year.

Only stray numbers were caught in gill net, the annual catch being 1.4 and 2.8 t forming 1 and 4% of the total sardine catch landed by this gear in the first and second years respectively.

However, at landing centres located 30 km south and 20 km north of Visakhapatnam (Outer Harbour) where gill net (10–40 mm mesh) is the dominant gear operated, about 35% of the gill nets sampled had oil sardine with a catch rate of 2–10 kg and average at 6 kg.

In the East Godavari district, oil sardine was recorded upto about 35 km north of Kakinada only. Absence of this fish in the catches towards south of Kakinada appears to be due to non-operation of small meshed gear. Along the coast north of Kakinada, oil sardine was reported to occur in at least 50% of the units of the indigenous gear and in most of the shrimp trawl during September–November, 1986. Oil sardine catches ranged between 0.5 and 8 kg with the average at 1kg in gill net and between 1 and 20 kg in shore seine. In a single shore seine operation on 22-9-1986 (night) about 3.6 tonnes of oil sardine were landed at Kothapatnam located about 20 km north of Kakinada. In shrimp trawl the catch rate of this fish was 1.0–4.2 kg per net. The fish was caught in depths of 5–30 m by the indigenous gear and 15–40 m by shrimp trawl.

Along the Gangapatnam–Ramatheertham coast of Nellore district, dip nets ('Kudupu vala') operated by 4–5 catamarans within half a kilometre from the shore have obtained a catch of 200–3,000 kg per day during the first quarter of 1985.

In Tamilnadu and Pondicherry, gill nets ('Thattaku vala valai', 'Kavala valai' and 'Chala valai'), boat seines and bag nets ('Edava valai', 'Madi valai', 'Thattumadi') accounted for most of the oil sardine landings. Along the coasts of Cuddalore, Mahabalipuram and Madras some gill nets landed 5–320 kg per net and bag nets upto 900 kg per net. Bulk of the catch came from 12-20 m depth. At Parangipettai, oil sardine catch of about 80 tonnes was recorded during October, 1985–September, 1986, bulk of which (71 t) being obtained during July–September, 1986. 'Kavala valai' and 'Salangai valai' contributed to this catch.

At Tuticorin the oil sardine catch was mainly obtained by gill net though sporadically. The annual landings during 1972–'85 ranged between 3.2 t in 1972 and 529.3 t in 1980 with the annual average at 92.3 t. Bulk of the catch was obtained during November–January accounting for 65.8% of the annual catch followed by August–October (21.8%) and February–May (12.43%). The ranges in catch (in kg) and their averages (given in paranthesis) for the above three periods were 0.4-21.3 (7.3), 0.2–17.1 (6.3) and 0.1–4.8 (1.4) respectively.

Table 3. *District-wise oil sardine landings (in tonnes) in Karnataka, Kerala, Andhra Pradesh and Orissa during* 1983–'86

S. No.	Districts	1983	1984	1985	1986
1.	N. Canara	4,061	6,087	11,651	11,370
2.	S. Canara	17,640	30,236	19,161	15,380
3.	Cannanore	9,748	8,216	3,445	880
4.	Kozhikode	12,309	13,348	16,237	13,839
5.	Malappuram	24,852	26,615	7,753	15,049
6.	Trichur	12,579	10,661	3,779	1,183
7.	Ernakulam	15,674	25,978	9,282	2,344
8.	Alleppey	21,623	23,296	12,159	6,677
9.	Quilon	53,493	38,596	25,801	624
10.	Trivandrum	4,594	420	769	890
11.	Kanyakumari	400	203	209	8
12.	Thirunelveli	1	—	494	183
13.	Ramanathapuram	312	262	—	—
14.	Pudukkottai	—	—	—	—
15.	Tanjore	—	2	69	564
16.	Pondicherry	141	920	1,374	1,797
17.	S. Arcot	511	718	1,282	3,316
18.	Madras	—	7	93	12
19.	Chingelpattu	96	3	749	2,010
20.	Nellore	—	—	131	—
21.	Prakasam	—	—	33	—
22.	Guntur	—	—	—	—
23.	Krishna	—	—	—	—
24.	West Godavari	—	—	—	—
25.	East Godavari	—	—	—	686
26.	Visakhapatnam	—	—	75	512
27.	Vizianagaram	—	—	24	57
28.	Srikakulam	—	—	—	—
29.	Ganjam	—	533	96	12
30.	Puri	—	4	—	—
31.	Cuttack	—	2	—	—
32.	Balasore	—	—	—	—

Length distribution

Oil sardine caught along the east coast ranged between 40 and 207 mm in total length. As gill nets are the major gear landing this fish at most centres, large sized fish, from around 125 mm length onwards, formed the major catch along the east coast.

Around Gopalpur, 120–175 mm size was caught in gill nets. Similar large sized fish were also caught in boat seines and shore seines. Good quantities of fish measuring 50–100 mm were caught during May–July and December, 1985 in drag nets (10–20 mm mesh size), boat seines and shore seines.

At Kakinada and adjacent centres towards north (East Godavari district), size ranges of 170–195 mm in gill net, 125–198 mm in shore seine and 160–195 mm in trawl net were observed during September–November, 1986.

At Visakhapatnam, fish caught in gill nets and shrimp trawls ranged in size of 100–175 mm and 70–165 mm respectively. But in boat seines it occurred in the size range of 40–205 mm. Dominant size ranges in different periods were 100–160 mm during July, '85–April, '86, 40–145mm during July, '86 – February, '87 and 60–135 mm during April–June, '87. Examination of Fig. 3 would reveal that from the parental stock that started occurring in the area around July,'85 with the dominant sizes at 100–105 mm the first progeny was recruited to the inshore catches at 50-85 mm size during May–July, '86 and the second progeny at 60–95 mm size during April-May, '87, thus indicating that the oil sardine has successfully bred in the sea off Visakhapatnam and is establishing itself in this area.

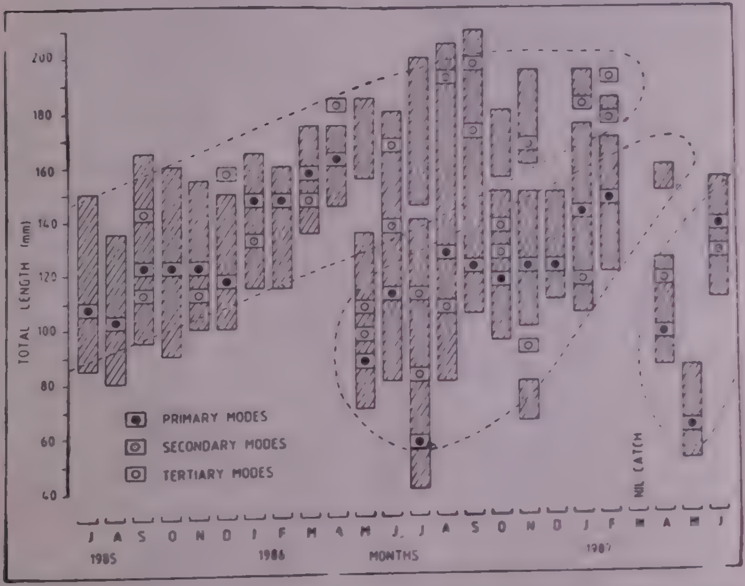

Fig. 3. Monthly total length ranges and length modes of oil sardine, landed by boat seine at Visakhapatnam Outer Harbour, during July, 1985 to June, 1987. (Length distributions of the parental stock and those of the two successive generations are delineated.)

In Tamilnadu–Pondicherry area the size range of 126-202 mm was recorded. At Pondicherry it was 140–202 mm in gill net landings during November-December, 1983 with bulk of the catch around 170 mm. At Madras during September, 1977 to March, '78 the size range of 126-195 mm with majority at 150–159 mm was met with in gill net catches. At Parangipettai fish of the size 102–193 mm, 60% of which being above 150 mm were recorded in 'Kavala valai' and 'Salangai valai' (both gill nets) during October, 1985 to September, '86. In the occasional samples examined during 1971-'73 and 1982–'84 at Tuticorin, the oil sardine occurred in the size range of 120–185 mm. Fish of 125-155 mm in size range with 135 and 140mm in modal lengths were common in the catches of both gill net (25 mm mesh size) and shore seine.

State of gonadal maturity

Information on this aspect is very scanty. Kuthalingam *(Treubia,* **25** (2): 202–213, 1960) reported on the eggs, newly hatched larvae, larvae upto 40 days after hatching and food of post-larvae of *Sardinella longiceps* from the Madras coast. Gnanamuthu and Girijavallabhan *(Indian J. Fish.,* **31** (3): 378-379, 1984) reported on the occurrence of mature oil sardine during January–March, 1978, off Madras. They have shown that ovaries in stage V possessed an advanced group of eggs measuring 0.63–0.648 mm and a less developed group measuring 0.37–0.396 mm. Males predominated the catches. At Pondicherry fish caught during November–December, 1983 had gonads in first and second stages of maturity and females outnumbered males (Srinivasarengan and Chidambaram, *Mar. Fish. Infor. Serv., T & E Ser.,* **61**: 16–17, 1985).

At Parangipettai fish in advanced stages of maturity were observed during July–September, 1986 and at Tuticorin in September, 1982, May, 1983 and March, 1984.

At Visakhapatnam, fish with gonads in advanced stages of maturity (V–VII) were met with from January–September, 1986 and in January–February, 1987. They formed 55% of the catch in January, 1986, 79% in February, 1986, 91–100% during March-September, 1986, 7% in January, 1987 and 29% in February, 1987. In October and November, 1986, gonads upto stage III only were met with in adult fish (beyond 149 mm total length). In December, 1986 only stages I and II were observed. In March, 1987 oil sardine was absent in the catches. From April to June, 1987 fish with gonads in stages I-II only were met with. However, there is evidence that the fish had spawned off Visakhapatnam during March–April, 1987 as juveniles in 50–80 mm size range formed the dominant catch of the species in May, 1987. According to Antony Raja *(Bull. cent. mar. Fish. Res. Inst.,* **16**: 1–128, 1969) *S. longiceps* attains 60–95 mm length when it is one month old. It appears that adult moves away from the near shore waters for spawning. The so-called parental stock of the oil sardine had a size range of 115–170 mm during January–March, 1986. During this period, the minimum size of fish with gonads in stage V and beyond was 115 mm. Fish in maturity stages V–VIIa (partially spent) formed 57% in the size range of 115–145 mm in January, about 79% in 115–145 mm in February, and 100% in 135–145 mm in March, 1986. Thereafter gonads in the above stages of maturity were rarely met with in fish below 149 mm length, except in February, 1987 when only 13% of the fishes in 130-140 mm length had gonads in stages V–VIIa. But with regard to fish of the first generation from the parental stock during July, 1986 to June, 1987 fish in advanced stages of maturity were not met with below 140 mm length group.

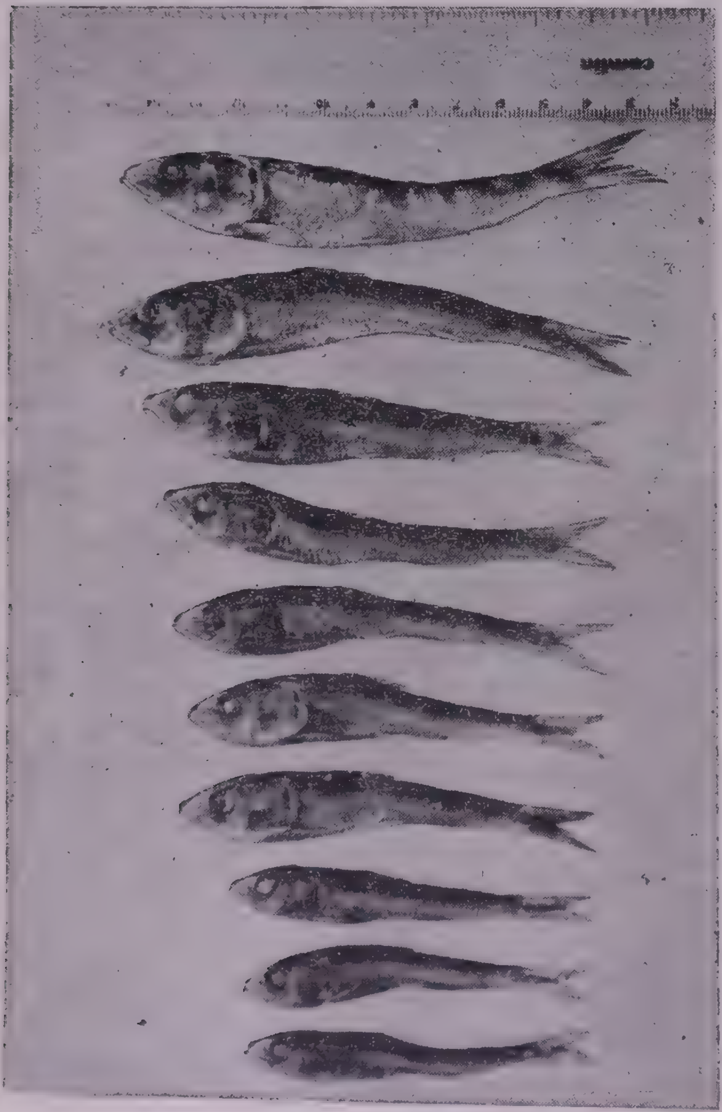

Fig. 4. Oil sardine *S. longiceps* in emaciated state met with during July – August, 1985 when this species made its debut into the regular fishery off Visakhapatnam.

Concomitant observations on oil sardine catches

One or a few of the following species of fishes were caught along with oil sardine at different centres along the east coast. They were *Sardinella fimbriata, S. gibbosa, S.dayi, Rastrelliger kanagurta,* and species of *Dussumieria, Stolephorus, Thryssa, Leiognathus, Cynoglossus, Gerres, Nemipterus, Trichiurus* and *Sphyraena.*

In Orissa, the fishermen of Chatrapuri-Ganjam area state that they have observed on many occasions large schools of oil sardine at the surface of the sea very close to Rushikulya river mouth.

Around Kakinada, very good catches of oil sardine were obtained in artisanal gear and shrimp trawl soon after the severe cyclone in August, 1986. Similarly good catches of oil sardine were obtained off Penna

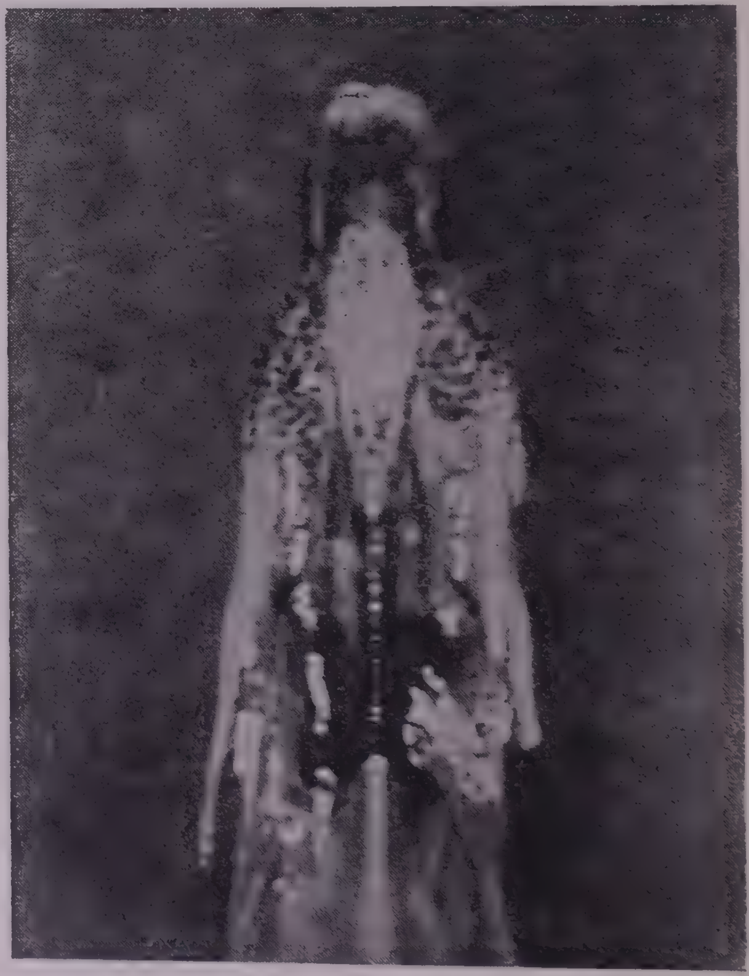

Fig. 5. Pattern of pigmentation on the tongue of *S. longiceps*, 140 mm total length.

river mouth in the Gangapatnam – Ramatheertham area in Nellore district.

Although the oil sardine has been occurring regularly in the catches of boat seines operated both within the break water area of the Visakhapatnam Outer Harbour and in the near-shore area since July, 1985, the extent of its distribution towards north (upto 50 km considered) and south (upto 44 km considered) of the harbour is rather restricted, to certain localities. Examination of the records of the fishery data of the Visakhapatnam and Vizianagaram districts reveals that oil sardine occurred in the catches of shore seine, boat seine or gill net (in which oil sardine is likely to be caught) in one out of 20 centres towards north and in four out of 13 centres towards south. They are Bheemunipatnam (22 km) in the north; four out of seven observations and in the south Dibbavalasa (6 km) two out of seven, Jalaripeta (Cheepurupalli, 22 km) one out of one, Thanthidi (26 km) one out of three and Poodimadaka (30 km) one out of ten observations. Interestingly, these landing centres are located in continuity with brackish water areas.

When the oil sardine occurred at Visakhapatnam, majority of fish were found to be very much emaciated, the prominent part of the fish being only the head (Fig. 4). Condition of feed of these fishes varied between 1/4 full to empty stomach.

Future Research

It is interesting to note that the oil sardine catches along the east coast are obtained mostly in areas close to harbours, backwaters and river mouths. This discontinuous distribution of the fish appears to indicate its affinity, particularly in its juvenile phase, to areas that have a certain admixture of fresh or brackishwater. Salinity as a limiting factor could perhaps be ruled out since the ambient salinity along the east coast is less than that along the west coast. Some other factor/factors associated with the brackishwater environment may have to be probed to explain this patchy occurrence of the oil sardine along the east coast. Intensive studies on the ecology of the oil sardine would help to elucidate and establish this relationship.

ON FIVE WHALE SHARKS LANDED ALONG THE TRIVANDRUM-KANYAKUMARI COAST*

Five whale sharks *Rhiniodon typus* Smith, were landed during April, 1988 at three centres on the south-west coast between St. Andrews in the Trivandrum district of Kerala and Colachel in the Kanyakumari district of Tamil Nadu. Silas *(Mar. Fish. Infor. Serv., T & E Ser.*, **66**, 1986) has listed an exhaustive collection of reports on the landings of whale sharks in the Indian and adjacent waters. Along the west coast of India alone there have been at least 57 instances of which seven are from the area covered in the present report.

The first of the present records (Fig. 1), a 6.06 m long female specimen weighing about two tonnes, was from Panathura fish landing centre, 10 km south of Trivandrum. The shark got enclosed in a shore seine operated within a km from shore at a maximum depth of 15 m. The net suffered considerable damage while being dragged ashore by a large contingent of fishermen.

About 40 numbers of sucker fish *(Echeneis* sp.). were found attached on its body surface by their suckers. Their physical attachment was firm until the shark was brought to shore and the fishermen removed them. The body measurements (in cm) of the shark are given below:

1.	Total length	: 606
2.	Standard length	: 458
3.	Head length	: 131
4.	Width of mouth from angle to angle	: 106
5.	Vertical height of 1st dorsal fin	: 56
6.	Vertical height of 2nd dorsal fin	: 25
7.	Vertical height of anal fin	: 22
8.	Length of caudal fin:	
	(i) along upper margin	: 148
	(ii) along lower margin (lower lobe)	: 91
9.	Snout to 1st dorsal	: 257
10.	Snout to 2nd dorsal	: 390
11.	Snout to pectoral	: 131
12.	Interspace between first and second dorsals	: 133
13.	Length of pectoral fin along outer margin	: 103

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* Reported by S. Lazarus, Jacob Jerold Joel, K. K. Philippose and S. G. Vincent, Vizhinjam Research Centre of CMFRI, Vizhinjam.

14. Length of pelvic fin : 40
15. Length of 1st dorsal : 72
16. Length of 2nd dorsal : 29
17. Tip of snout to 1st gill slit : 92.5

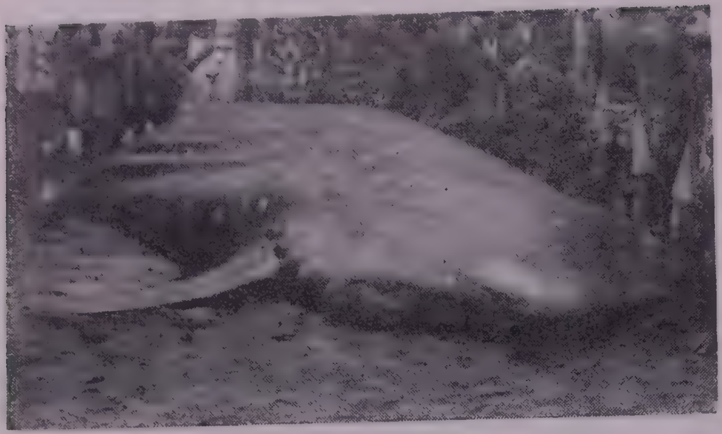

Fig. 1. Whale shark *Rhiniodon typus* Smith, caught at Panathura.

The second instance was at St. Andrews, a fishing village near Thumba, which is about 15 km north of Trivandrum. This male specimen was encountered in a shore seine on the same day at about 10 A.M. The measurements collected were: length of upper caudal lobe – 197 cm, length of lower caudal lobe - 127 cm and height of caudal peduncle – 40 cm.

The liver in both the cases was removed for extracting oil and the rest, except for the caudal fins, was towed back and discarded in the sea.

The other three specimens were landed on 18–4–1988 at 12.30 P.M. at Kottilpadu, a fishing village near Colachel. The only information about the specimens was from a Tamil daily ('Dinamalar' dated 20–4–1988) which reported that each specimen was 24 feet long and weighed 1,500 kg each.

Satyanarayana Rao *(Mar. Fish. Infor. Serv., T & E Serv.,* **66**, 1986) has recorded five cases of whale shark landing within a span of 24 days in a 40 km stretch caught from 16 to 27 m depth in Dakshina Kannada coast. In the present case the five specimens were landed within 14 days within a coastal stretch of about 70 km caught from less than 15 m depth.

RECORD CATCH OF TIGER SHARKS FROM MAHARASHTRA COAST*

Tiger sharks are large in size, and predacious. They are known to enter shallow waters and are the dread of bathers. Records of landings of large tiger sharks are scanty. Leonard *(FAO Species Catalogue,* **4** (2): 503-506, 1984) has reported this shark as loner, but forming schools only while feeding. This accounts for the fact that bulk landings of large tiger sharks are rarely reported. In this communication the schooling habit of tiger sharks and their capture in large numbers using hooks and line are reported.

R. V. Saraswathi on its 37th cruise operated hooks and line on 20–4–'85 in the area 18–72/IC where the depth sounded at 300 m. Freshly caught and cut cat fish was used as bait. This resulted in a catch of six large tiger sharks *(Galeocerdo cuvieri)* measuring over 2 m in length and approximately 500 kg in weight. The largest specimen was a female which measured 380 cm in length and weighed 100 kg.

The sharks hooked were more than six in number but many of them managed to escape by breaking the lines that held them. Power winch had to be employed to haul the sharks to the deck as they could not be handled by man power.

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* Reported by M. Aravindakshan, Bombay Research Centre of CMFRI, Bombay.

REPORT ON TWO DOLPHINS WASHED ASHORE NEAR MANDAPAM*

Although smaller cetaceans are common in Mandapam area, reports on dolphins washed ashore are rare. This communication reports on two dolphins washed ashore; one near Krusadi Island in the Gulf of Mannar and the other near CMFRI Fish Farm on Palk Bay side during 1985.

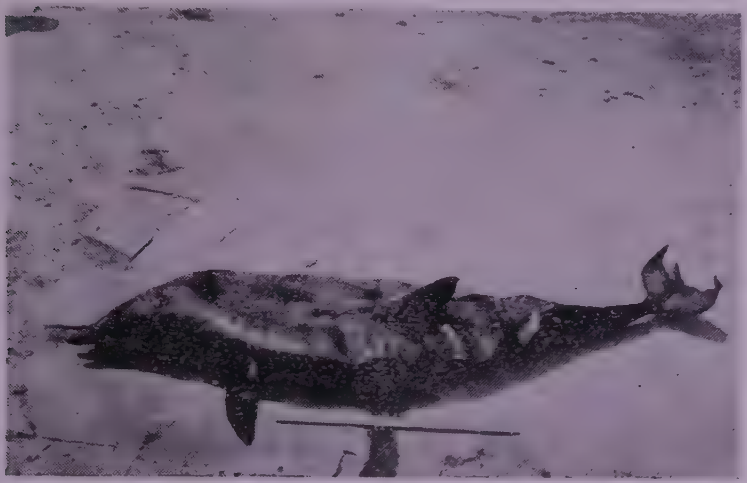

Fig. 1. *Tursiops aduncus*

The specimen observed on 28–1–1985 measured 150 cm in total length and weighed 30 kg. It was identified as *Tursiops aduncus* (Fig. 1). Twenty one teeth were noticed on one side of the upper jaw, the others being in the developing stage embedded in the sockets on the jaws. The teeth were not fully developed in the lower jaw. Marks of injury in the form of cut was seen on the lateroventral side. The detailed morphometric measurements of the specimens are given below.

The dolphin washed ashore near CMFRI Fish Farm on the Palk Bay side was observed on 5–2–1985. Local enquiries revealed that the dolphin was noticed on 25–1–1985. This was identified as *Sousa chinensis* and it measured 225 cm in total length. The caudal region was severely injured which might be the cause for the death. As the dolphin was in advanced stage of decomposition, detailed measurements could not be taken.

The dolphins have a tendency to follow the boats, particularly the cod end of the trawls while fishing. The present observation suggests, that the injuries on these dolphins might have been caused by the propeller of the boat.

1.	Name of the species	*Tursiops aduncus*	*Sousa chinensis*
2.	Date of observation	28–1–1985	5–2–1985
3.	Total length	150	225
4.	Length from tip of snout to blowhole	27	—
5.	Length from tip of snout to centre of eye	25	—
6.	Length from tip of snout to origin of dorsal fin	—	97
7.	Length from tip of snout to anterior insertion of flipper	38	61
8.	Length from tip of snout to centre of anus	84	121
9.	Length from notch of fluke to posterior end of dorsal fin	60	—
10.	Length from notch of fluke to centre of anus	59	—
11.	Length of fluke on outer curvature	24	—
12.	Length of fluke on inner curvature	16	—
13.	Distance between extremities of fluke	22	—
14.	Length of dorsal fin base	17	—
15.	Vertical height of dorsal fin	16	—
16.	Length of flipper from anterior insertion to tip	24	—
17.	Length of flipper along curve of lower border	15	—
18.	Greatest width of flipper	11	—
19.	Depth of body at anal region	65	—
20.	Depth of body at origin of flipper	73	—
21.	Depth of body at origin of dorsal	84	—
22.	Height of dorsal fin	—	54
23.	Length of upper jaw	20	—
24.	Length of lower jaw	21	—
25.	Diameter of eye	2	—
26.	Total number of teeth on one side of upper jaw	21	31
27.	Total number of teeth on one side of lower jaw	Not fully developed	31
28.	Sex	Male	Female

All measurements in cm.

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* Reported by S. Krishna Pillai and C. Kasinathan, Regional Centre of CMFRI, Mandapam Camp.

* * *

Edited by Dr. K. J. Mathew, Mr. I. David Raj and Mr. G. S. D. Selvaraj. Published by Dr. K. J. Mathew on behalf of the Director Central Marine Fisheries Research Institute, Cochin-682 031. Printed at PAICO, Cochin-31.

MARINE FISHERIES INFORMATION SERVICE

8/9/89

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No. 89
NOVEMBER 1988

Technical and Extension Series

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THE MARINE FISHERIES INFORMATION SERVICE: Technical and Extension Series envisages the rapid dissemination of information on marine and brackish water fishery resources and allied data available with the National Marine Living Resources Data Centre (NMLRDC) and the Research Divisions of the Institute, results of proven researches for transfer of technology to the fish farmers and industry and of other relevant information needed for Research and Development efforts in the marine fisheries sector.

Abbreviation – *Mar. Fish. Infor. Serv., T & E Ser.,* No. **89**: 1988

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5. Unusual landing of cat fish *Tachysurus dussumieri* at Madras

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Front cover photo:

Bombay duck *(Harpadon nehereus)* a common fish resource of the Maharashtra-Gujarat coasts.

Back cover photo:

Trawlers moored at Sassoon Dock fish landing centre in Bombay.

MARINE FISH CALENDAR

XI. BOMBAY*

P. V. Kagwade, S. K. Chakraborty, Mohamed Zafar Khan and J. D. Sarang
Bombay Research Centre of CMFRI, Bombay

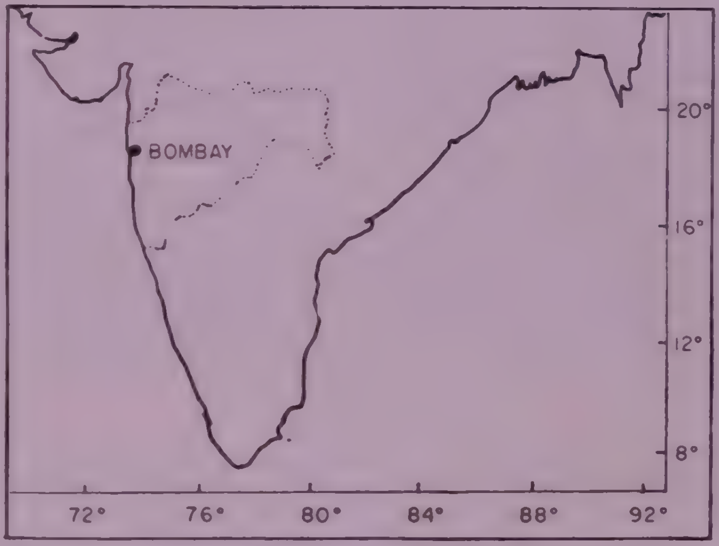
Introduction

There are three major fish landing centres in Bombay, namely Sassoon Dock, Versova and New Ferry Wharf. Of these, the former two are very old centres while the New Ferry Wharf is about a decade old. Sassoon Dock is a major centre where fishing activities are the maximum throughout the year, except during inclement weather. The fishing activities at Versova during monsoon are sporadic and limited to nearshore fishing by miniature bag net ('Bokshi'), cast net and shore seine. The boat owners and the crew at New Ferry Wharf are mostly from Gujarat and hence, they return to their native places during monsoon with the result that there is hardly any fishing worth drawing attention. Catch data from Sassoon Dock are made use of in the preparation of this marine fish calendar.

The crafts at Sassoon Dock are all mechanised and the gear used are mainly trawl net, bag net called 'dol' and gill net, their mesh sizes being 20-25, 15-20 and 80 to 120 mm respectively. All these gears operate all round the year, the trawl at 60-90 m, 'dol' at 10-30 m and gill net at 30-60 m depth zones. On an average daily 70 trawlers, 25-30 'dol' netters and 15-20 gill netters operate. In addition there are 30 units of hooks and line operating from September to April at a depth of about 30m. Their landings are very meagre and comprised of cat fish, shark and occasionally eel. Data used for this calendar are the annual and monthly averages of the catches of the three year period from 1983 to '85 for the three major gears.

The trawl catch has many groups of fishes occurring in different magnitude. The major groups are sciaenids, cat fishes and clupeids forming 5.01, 4.83 and 4.09% respectively in the catch. Sharks, ribbon fishes, threadfin breams, lizard fishes and rays contribute 3.98, 3.43, 2.70, 2.11 and 1.24% respectively to the total catch. The remainings are minor groups forming less than 1% in the total catch.

Bombay duck is the predominant fish forming 25.65% in the 'dol' net catch. Other varieties like clupeids, sciaenids, pomfrets, eels and ribbon fishes form less than 4% each in the catch.



Pomfrets, both silver and black, forming 28.6% dominate the gill net catch. This is followed by clupeids, tunas and seer fishes constituting 20.2, 20.0 and 14.8% respectively. Sciaenids, sword fishes and horse mackerel form between 3.7 and 7.4%.

BOTHIDAE

Popular English Name : Indian halibut
Vernacular Name (Marathi) : 'Bakus'
Annual average catch : —
Percentage in total catch : —
Fishing methods and their contribution : Trawl net: —

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* Consolidated by N. Gopinatha Menon and K. Balachandran, CMFRI, Cochin.

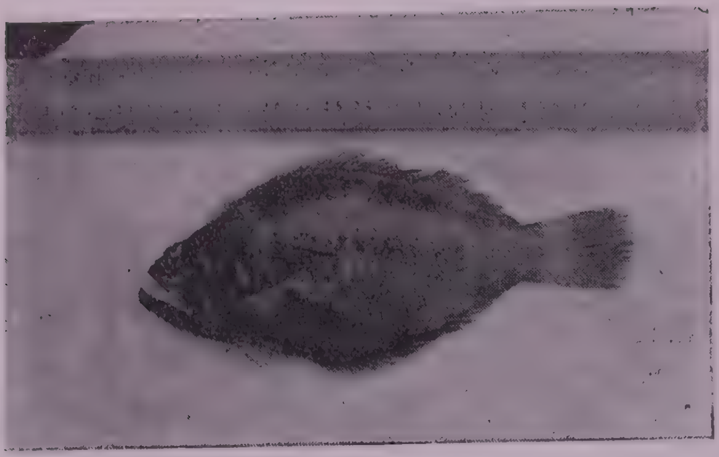

Fig. 1. *Psettodes erumei*

Scientific Name : *Psettodes erumei*
Vernacular Name : 'Bakus'
Percentage in the catch of the group : —
Peak period of occurrence : Dec. – Jan.
Depth of occurrence : 30 – 60 m
Length range in commercial fishery : 140 – 620 mm
Size at first maturity : —
Spawning season : Sep. – Oct.

CARANGIDAE

Popular English Name : Horse mackerel
Vernacular Name (Marathi) : 'Kati bangada'
Annual average catch : 57 t
Percentage in total catch : 0.4
Fishing methods and their contribution : Gill net: —

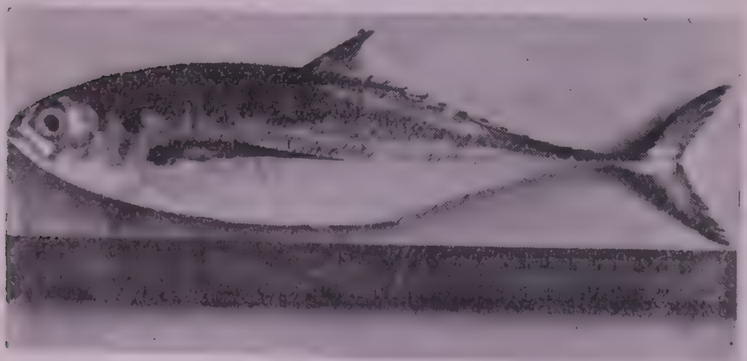

Fig. 2. *Megalaspis cordyla.*

Scientific Name : *Megalaspis cordyla*
Vernacular Name : 'Kati bangada'
Gear : Gill net
Percentage in the catch of the group : —
Peak period of occurrence : Aug. – Dec.
Depth of occurrence : 30 – 60 m
Length range in commercial fishery : 110 – 350 mm
Size at first maturity : —
Spawning season : Dec. – Feb.

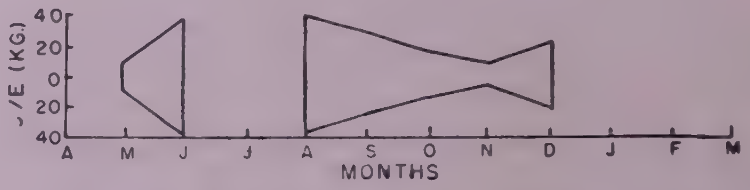

Fig. 3. Seasonal abundance of Horse mackerel *(Megalaspis cordyla)* in gill net catch

CLUPEIDAE AND CHIROCENTRIDAE

Popular English Name : Herring/Silverbar/Golden anchovy
Vernacular Name (Marathi) : 'Karli'/'Datali'/'Bhing'/'Kati'/'Mandeli'
Annual average catch : 1,739 t
Percentage in total catch : 13.6
Fishing methods and their contribution : Trawl net/Gill net/Dol net: —

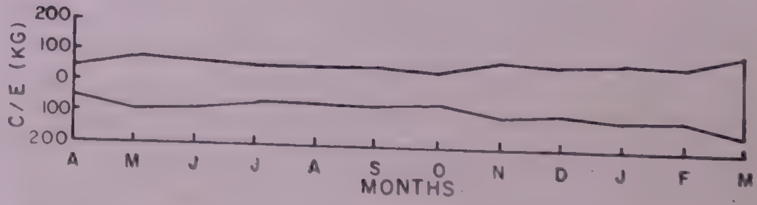

Fig. 4. Seasonal abundance of clupeids in trawl net catch.

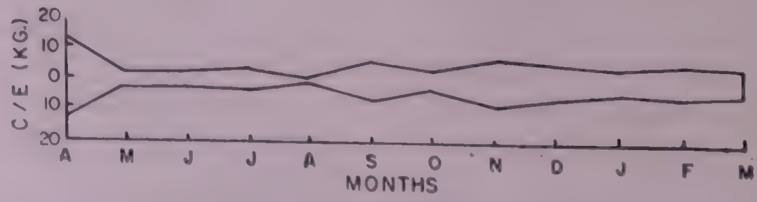

Fig. 5. Seasonal abundance of clupeids in dol net catch.

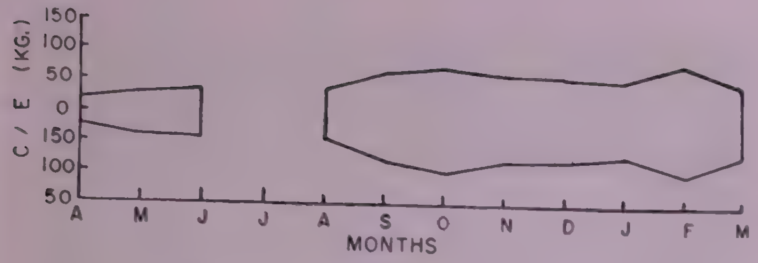

Fig. 6. Seasonal abundance of clupeids in gill net catch.

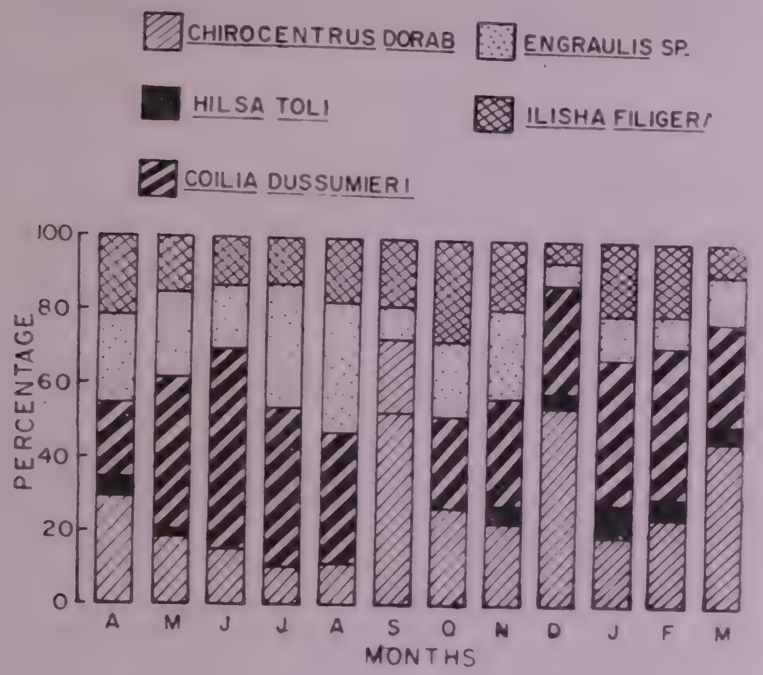

Fig. 7. Monthly species composition of clupeids in trawl net catch.

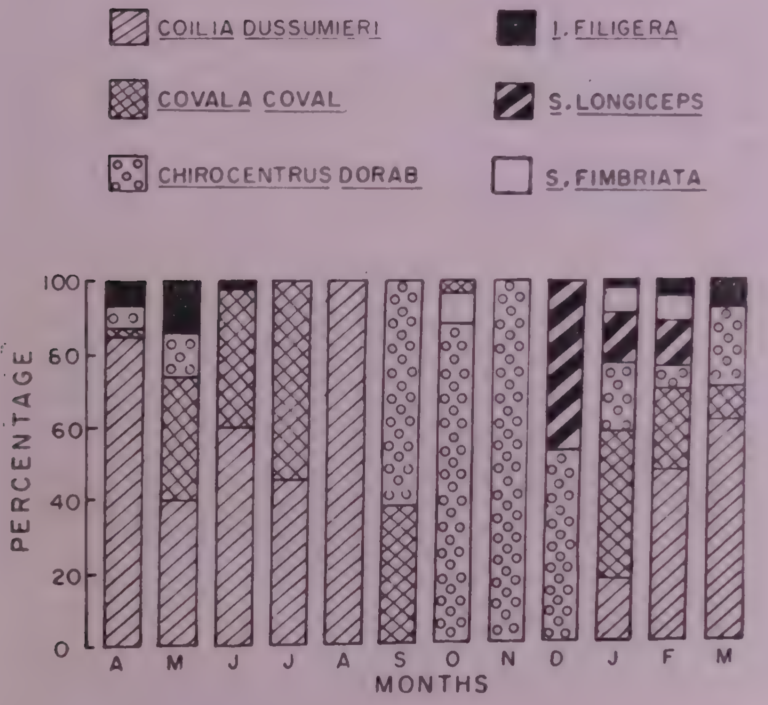

Fig. 8. Monthly species composition of clupeids in dol net catch.

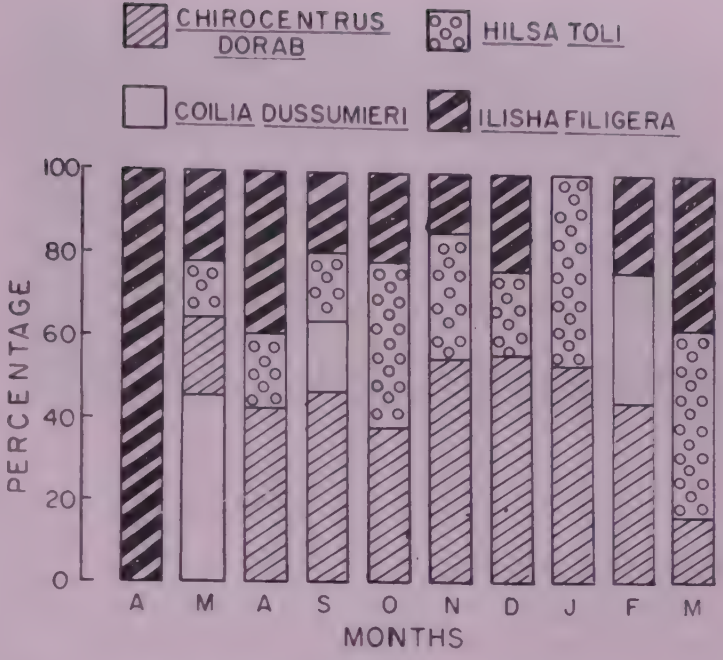

Fig. 9. Monthly species composition of clupeids in gill net catch.

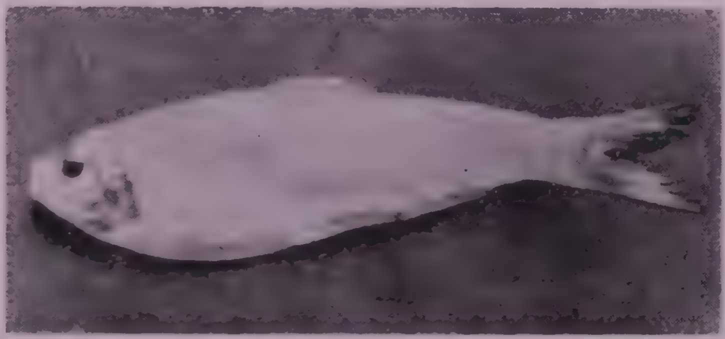

Fig. 10. *Escualosa thoracata.*

Scientific Name : *Escualosa thoracata*
Vernacular Name : 'Bhilgee'
Gear : Dol net
Percentage in the catch of the group : 37.9
Peak period of occurrence : May – Jul.
Depth of occurrence : 10 – 15 m
Length range in commercial fishery : 60 – 80 mm
Size at first maturity : —
Spawning season : —

Scientific Name : *Tenualosa toli*
Vernacular Name : 'Bhing'
Gear : Trawl net/Dol net
Percentage in the catch of the group : Trawl net : 3.4
: Dol net : 30.3
Peak period of occurrence : May – Jan.

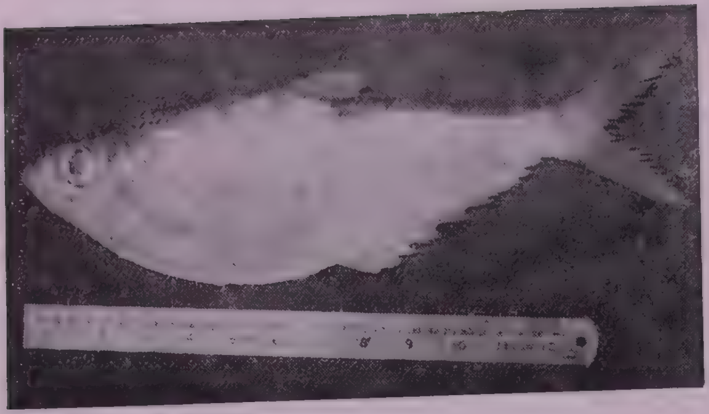

Fig. 11. *Tenualosa toli.*

Depth of occurrence : 30 – 60 m
Length range in commercial fishery : 320 – 400 mm
Size at first maturity : —
Spawning season : —

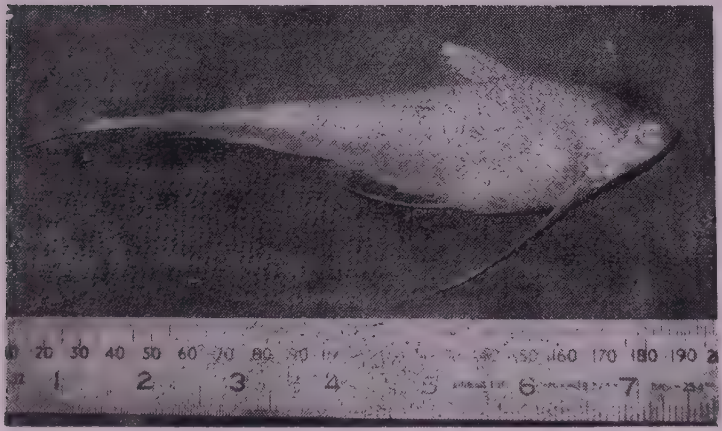

Fig. 12. *Coilia dussumieri.*

Scientific Name : *Coilia dussumieri*
Vernacular Name : 'Mandeli'
Gear : Trawl net/Dol net
Percentage in the catch of the group : Trawl net : 33.6
Dol net : 31.8
Peak period of occurrence : Jun. – Aug. and Dec. - Feb.
Depth of occurrence : 10 – 30 and 60 – 90 m
Length range in commercial fishery : 80 – 180 mm
Size at first maturity : 140 mm
Spawning season : Sep. – Mar.

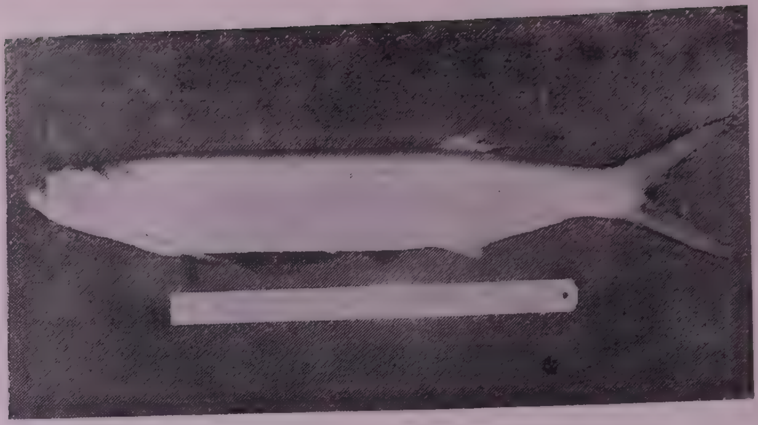

Fig. 13. *Chirocentrus dorab.*

Scientific Name : *Chirocentrus dorab*
Vernacular Name : 'Karli'/'Datali'
Gear : Trawl net/Gill net/Dol net
Percentage in the catch of the group : Trawl net : 38.9
Gill net : 46.7
Dol net : 22.7
Peak period of occurrence : Aug. – Apr.
Depth of occurrence : 10 – 90 m
Length range in commercial fishery : 420 - 860 mm
Size at first maturity : —
Spawning season : Jul. – Aug.

CYNOGLOSSIDAE

Popular English Name : Soles
Vernacular Name (Marathi) : 'Lepti'
Annual average catch : —
Percentage in total catch : —
Fishing methods and their contribution : Trawl net: —

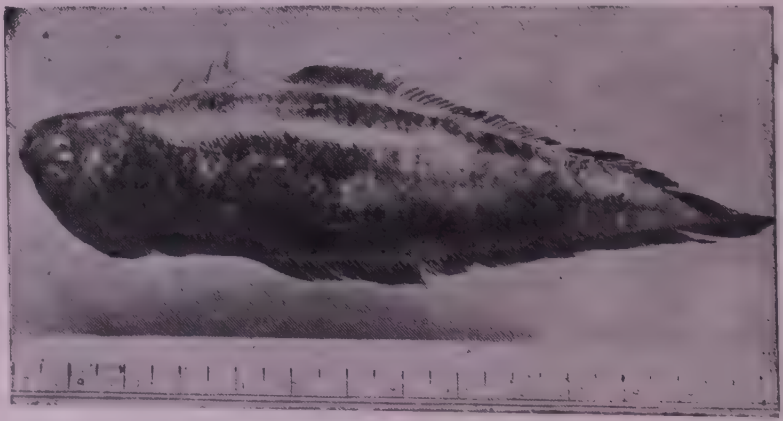

Fig. 14. *Cynoglossus macrostomus.*

Scientific Name : *Cynoglossus macrostomus*
Vernacular Name : 'Lepti'
Gear : Trawl net
Percentage in the catch of the group : —
Peak period of occurrence : Aug. - Oct.
Depth of occurrence : 30 - 60 m
Length range in commercial fishery : 120 - 340 mm
Size at first maturity : —
Spawning season : —

ELASMOBRANCHS

Popular English Name : Sharks/Skates/Rays
Vernacular Name (Marathi) : 'Mushi'/'Pakat'/'Ranja'/'Lani'/'Pok'
Annual average catch : 2,198 t
Percentage in total catch : 17.2
Fishing methods and their contribution : Trawl net: —

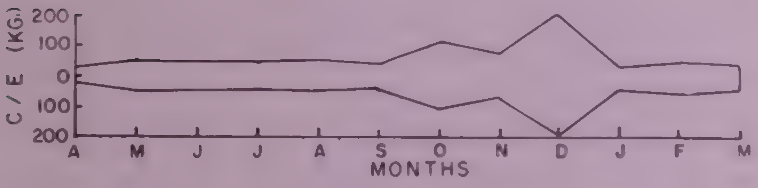

Fig. 15. Seasonal abundance of sharks in trawl net catch.

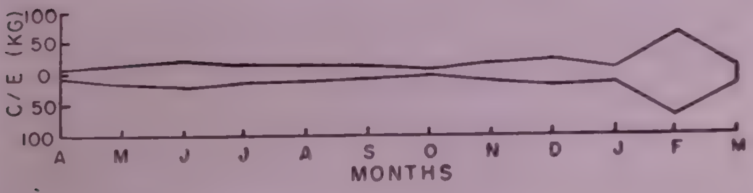

Fig. 16. Seasonal abundance of rays in trawl net catch.

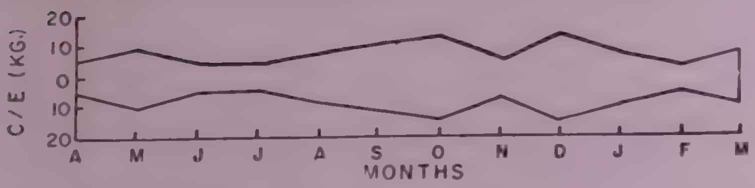

Fig. 17. Seasonal abundance of skates in trawl net catch.

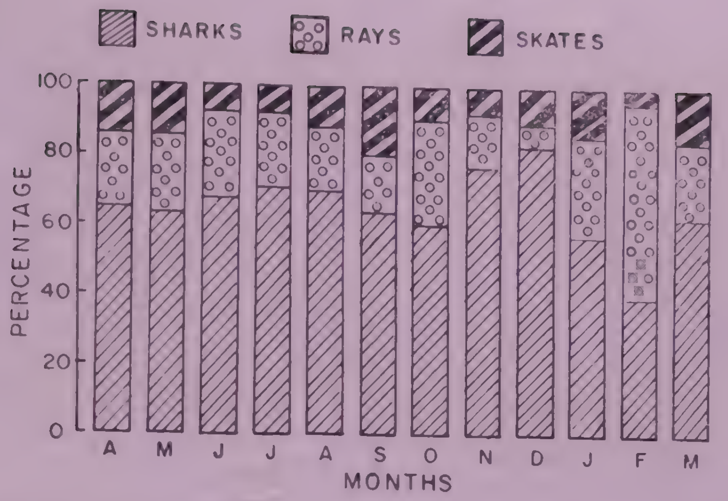

Fig. 18. Monthwise catch composition of elasmobranchs by trawl net catch.

HARPADONTIDAE

Popular English Name : Bombay duck
Vernacular Name (Marathi) : 'Bombil'
Annual average catch : 443 t
Percentage in total catch : 3.5
Fishing methods and their contribution : Dol net: —

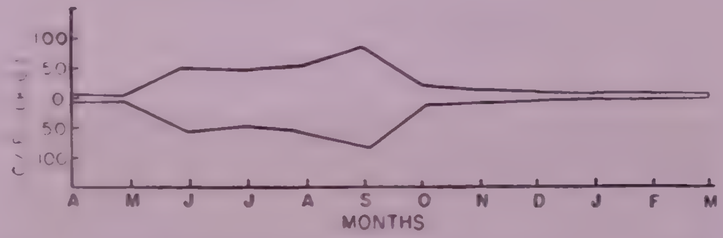

Fig. 19. Seasonal abundance of Bombay duck in dol net catch·

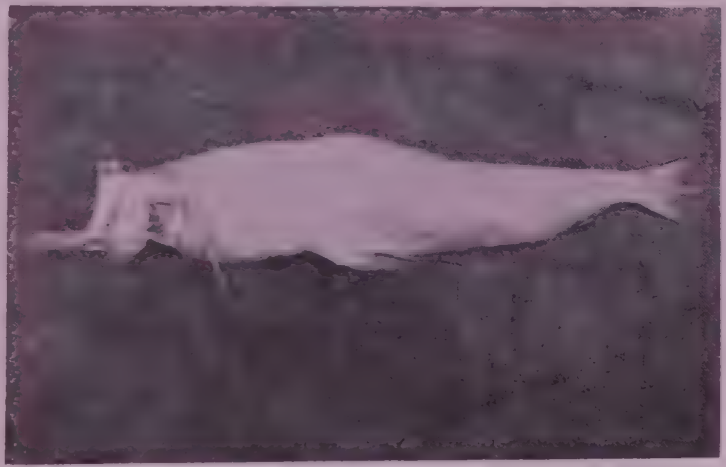

Fig. 20. *Harpadon nehereus.*

Scientific Name : *Harpadon nehereus*
Vernacular Name : 'Bombil'
Gear : Dol net

Percentage in the catch of the group : 100
Peak period of occurrence : Jun. – Oct.
Depth of occurrence : 10 - 30 m
Length range in commercial fishery : 40 – 350 mm
Size at first maturity : 210 mm
Spawning season : Nov. – Dec.

MULLIDAE

Popular English Name : Goat fish
Vernacular Name (Marathi) : 'Raja'
Annual average catch : 272 t
Percentage in total catch : 2.1
Fishing methods and their contribution : Trawl net: —

MURAENESOCIDAE

Popular English Name : Eel
Vernacular Name (Marathi) : 'Wam'
Annual average catch : 49 t
Percentage in total catch : 0.4
Fishing methods and their contribution : Trawl net: —
Dol net : —

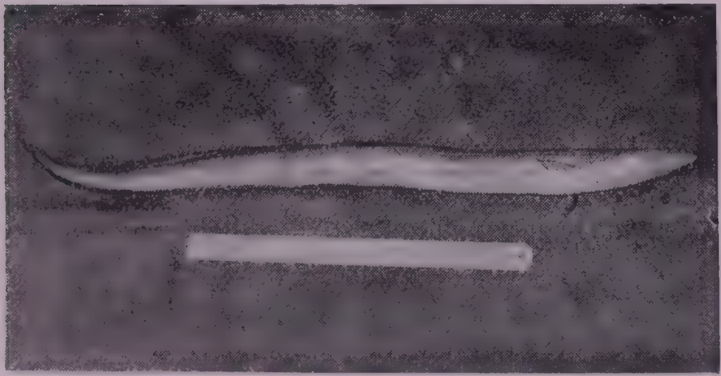

Fig. 21. *Muraenesox talabonoides.*

Scientific Name : *Muraenesox talabonoides*
Vernacular Name : 'Wam'
Gear : Trawl net/Dol net
Peak period of occurrence : Jan. – May and Oct. – Dec.
Depth of occurrence : 10 – 60 m
Length range in commercial fishery : 400 - 2,000 mm
Size at first maturity : 1,200 mm
Spawning season : Apr. – May and Sep. – Oct.

NEMIPTERIDAE

Popular English Name : Threadfin bream
Vernacular Name (Marathi) : 'Rani'
Annual average catch : 1,002 t
Percentage in total catch : 7.9
Fishing methods and their contribution : Trawl net: —

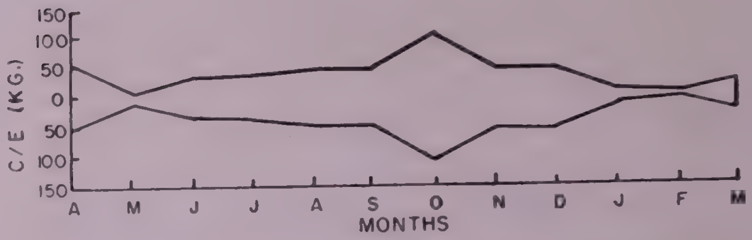

Fig. 22. Seasonal abundance of threadfin breams in trawl net catch.

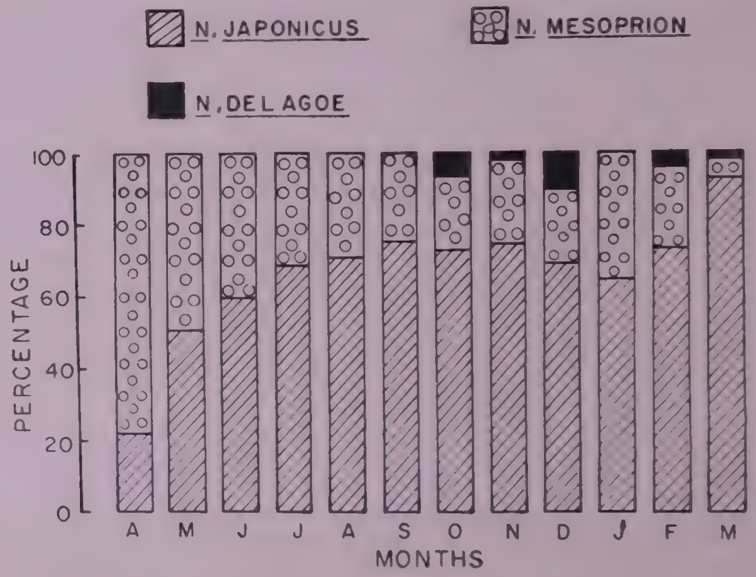

Fig. 23. Monthly species composition of threadfin breams in trawl net catch.

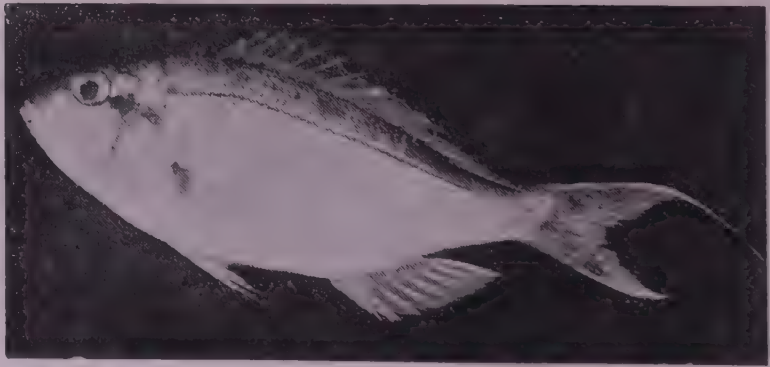

Fig. 24. *Nemipterus japonicus.*

Scientific Name : *Nemipterus japonicus*
Vernacular Name : 'Rani'
Gear : Trawl net

Percentage in the catch of the group : Trawl net : 65.2
Peak period of occurrence : Nov. - Jan.
Depth of occurrence : 60 - 90 m
Length range in commercial fishery : 130 - 290 mm
Size at first maturity : —
Spawning season : —

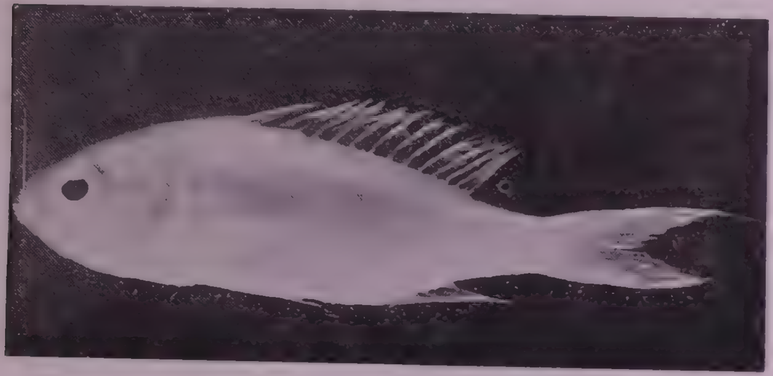

Fig. 25. *Nemipterus mesoprion.*

Scientific Name : *Nemipterus mesoprion*
Vernacular Name : 'Rani'
Gear : Trawl net
Percentage in the catch of the group : Trawl net: 32.2
Peak period of occurrence : Nov. - Jan.
Depth of occurrence : 60 - 90 m
Length range in commercial fishery : 140 - 320 mm
Size at first maturity : —
Spawning season : —

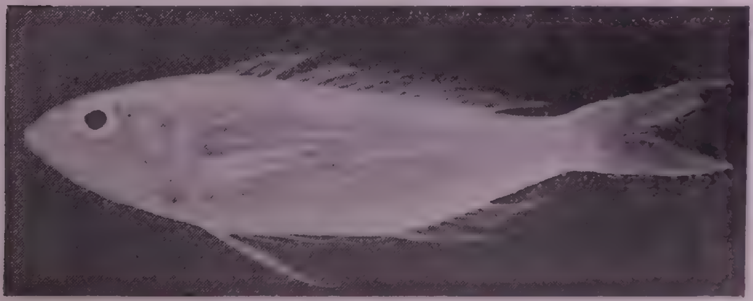

Fig. 26. *Nemipterus delagoae.*

Scientific Name : *Nemipterus delagoae*
Vernacular Name : 'Rani'
Gear : Trawl net
Percentage in the catch of the group : Trawl net : 2.7
Peak period of occurrence : Dec.
Depth of occurrence : 60 - 90 m
Length range in commercial fishery : —
Size at first maturity : —
Spawning season : —

SCIAENIDAE

Popular English Name : Croakers/Jew fish/Drummers
Vernacular Name (Marathi) : 'Dhoma'
Annual average catch : 1,898 t
Percentage in total catch : 14.9
Fishing methods and their contribution : Trawl net/Gill net/Dol net: —

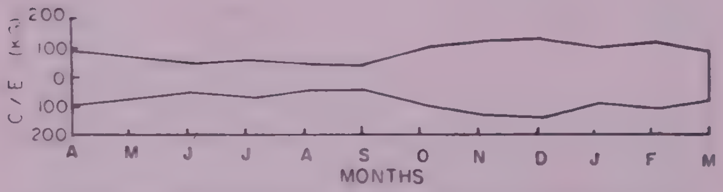

Fig. 27. Seasonal abundance of sciaenids in trawl net catch.

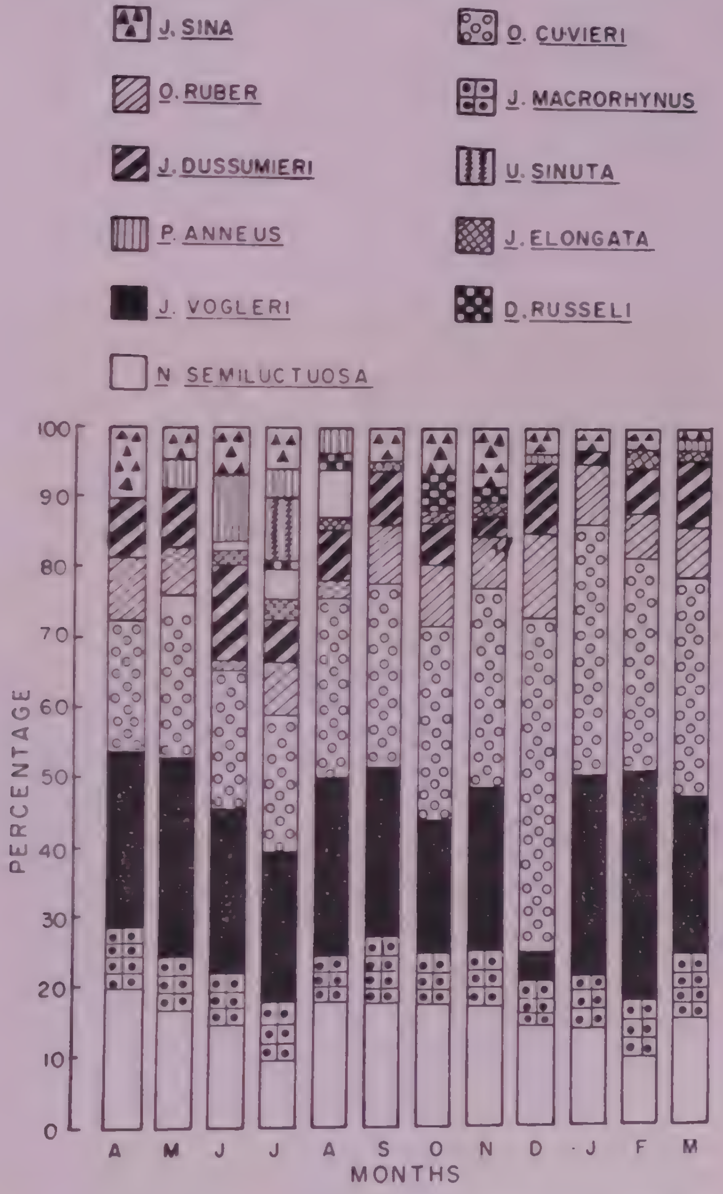

Fig. 28. Monthly species composition of sciaenids in trawl net catch.

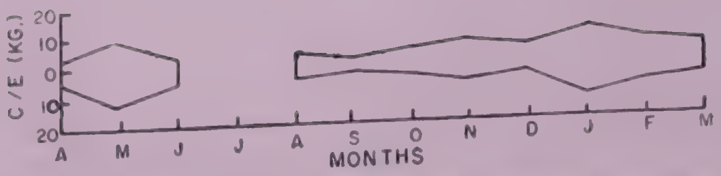

Fig. 29. Seasonal abundance of Ghol *(P. diacanthus)* in gill net catch.

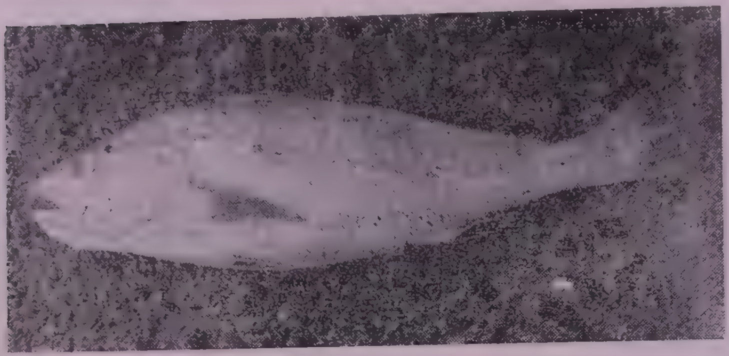

Fig. 30. *Protonibea diacanthus.*

Scientific Name : *Protonibea diacanthus*
Vernacular Name : 'Ghol'
Gear : Trawl net/Gill net/Dol net
Percentage in the catch of the group : Trawl net : 8.7
Peak period of occurrence : Aug. – May
Depth of occurrence : 10 – 90 m
Length range in commercial fishery : 200 – 1,200 mm
Size at first maturity : 850 mm
Spawning season : Jun. - Sep.

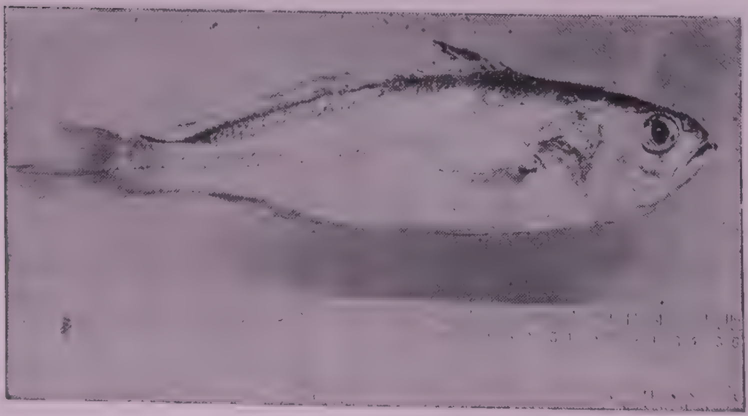

Fig. 31. *Otolithes ruber.*

Scientific Name : *Otolithes ruber*
Vernacular Name : 'Dhoma'
Gear : Trawl net
Percentage in the catch of the group : Trawl net : 6.0
Peak period of occurrence : Occasional
Depth of occurrence : 60 – 90 m
Length range in commercial fishery : —
Size at first maturity : —
Spawning season : Jul. – Oct.

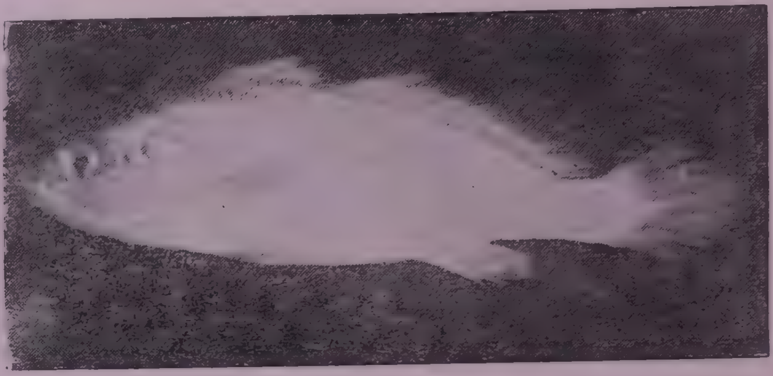

Fig. 32. *Otolithes cuvieri.*

Scientific Name : *Otolithes cuvieri*
Vernacular Name : 'Dhoma'
Gear : Trawl net
Percentage in the catch of the group : Trawl net : 26.2
Peak period of occurrence : Oct. – Dec.
Depth of occurrence : 60 – 90 m
Length range in commercial fishery : 140 – 310 mm
Size at first maturity : 170 mm
Spawning season : Jul. – Sep.

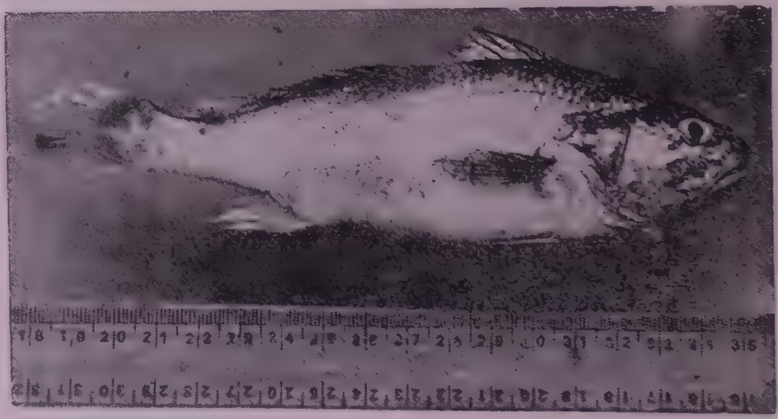

Fig. 33. *Johnius dussumieri.*

Scientific Name : *Johnius dussumieri*
Vernacular Name : 'Dhoma'
Gear : Trawl net
Percentage in the catch of the group : Trawl net : 6.2
Peak period of occurrence : Mar. – Apr.

Depth of occurrence : 60 - 90 m
Length range in commercial fishery : —
Size at first maturity : —
Spawning season : —

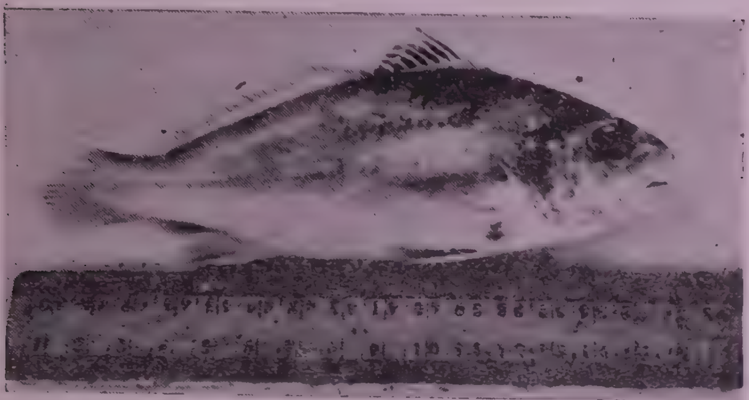

Fig. 34. *Johnieops sina.*

Scientific Name : *Johnieops sina*
Vernacular Name : 'Dhoma'
Gear : Trawl net
Percentage in the catch of the group : Trawl net : 4.2
Peak period of occurrence : Jan. - May
Depth of occurrence : 60 – 90 m
Length range in commercial fishery : —
Size at first maturity : —
Spawning season : —

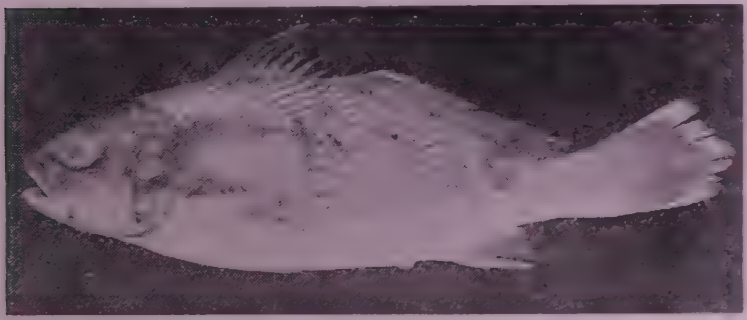

Fig. 35. *Johnieops vogleri.*

Scientific Name : *Johnieops vogleri*
Vernacular Name : 'Dhoma'
Gear : Trawl net
Percentage in the catch of the group : Trawl net : 23.8
Peak period of occurrence : Jan. – Mar.
Depth of occurrence : 60 – 90 m
Length range in commercial fishery : 120 – 290 mm
Size at first maturity : 150 mm
Spawning season : Jul. – Sep

SCOMBRIDAE

Popular English Name : Mackerel/Seer fish/Tuna
Vernacular Name (Marathi) : 'Surmai'/'Kuppa'/'Gedra'
Annual average catch : 540 t
Percentage in total catch : 4.2
Fishing methods and their contribution : Gill net: —

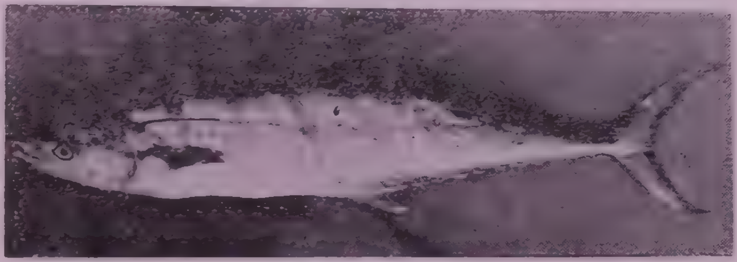

Fig. 36. *Scomberomorus commerson.*

Scientific Name : *Scomberomorus commerson*
Vernacular Name : 'Surmai'
Gear : Gill net
Percentage in the catch of the group : —
Peak period of occurrence : Oct. – Dec.
Depth of occurrence : 30 – 60 m
Length range in commercial fishery : 550 – 1,200 mm
Size at first maturity : —
Spawning season : —

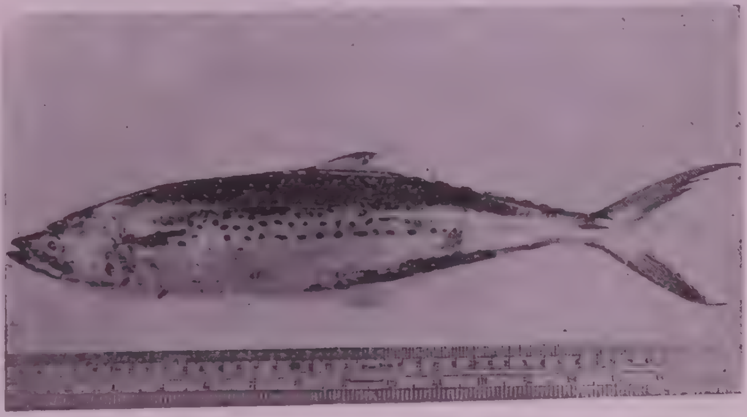

Fig. 37. *Scomberomorus guttatus.*

Scientific Name : *Scomberomorus guttatus*
Vernacular Name : 'Surmai'
Gear : Gill net
Percentage in the catch of the group : —
Peak period of occurrence : Oct. – Dec.
Depth of occurrence : 30 – 60 m
Length range in commercial fishery : 350 – 550 mm
Size at first maturity : —
Spawning season : Apr. – Jun.

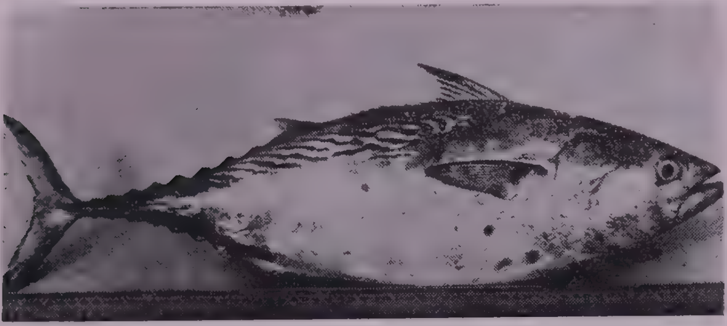

Fig. 38. *Euthynnus affinis.*

Scientific Name : *Euthynnus affinis*
Vernacular Name : 'Kuppa'/'Gedra'
Gear : Gill net
Percentage in the catch of the group : —
Peak period of occurence : Oct. – Dec.
Depth of occurrence : 30 – 60 m
Length range in commercial fishery : 300 - 700 mm
Size at first maturity : —
Spawning season : Apr. - Sep.

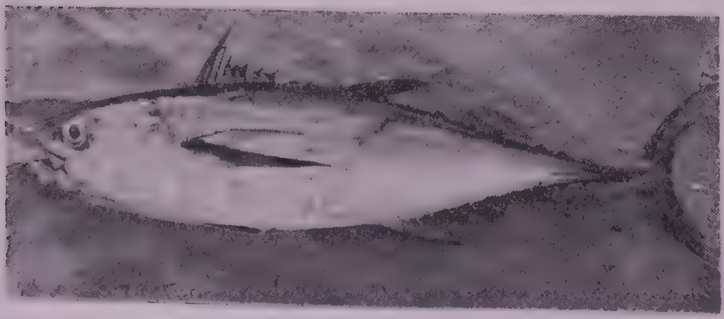

Fig. 39. *Thunnus tonggol.*

Scientific Name : *Thunnus tonggol*
Vernacular Name : 'Kuppa'/'Gedra'
Gear : Gill net
Percentage in the catch of the group : —
Peak period of occurence : Oct. – Dec.
Depth of occurrence : 30 – 60 m
Length range in commercial fishery : 350 - 750 mm
Size at first maturity : —
Spawning season : —

STROMATIDAE

Popular English Name : Pomfrets
Vernacular Name (Marathi) : 'Paplet'/'Sarga'/'Saranga'/'Halwa'
Annual average catch : 845 t
Percentage in total catch : 6.6
Fishing methods and their contribution : Trawl net/Gill net/Dol net: —

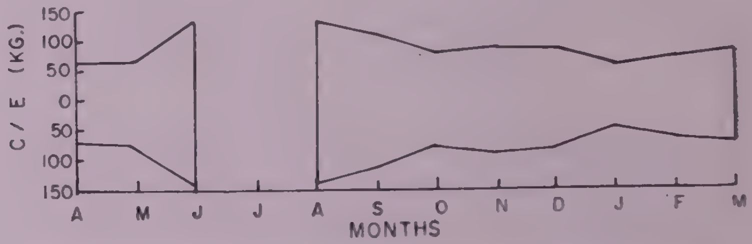

Fig. 40. Seasonal abundance of pomfrets in gill net catch.

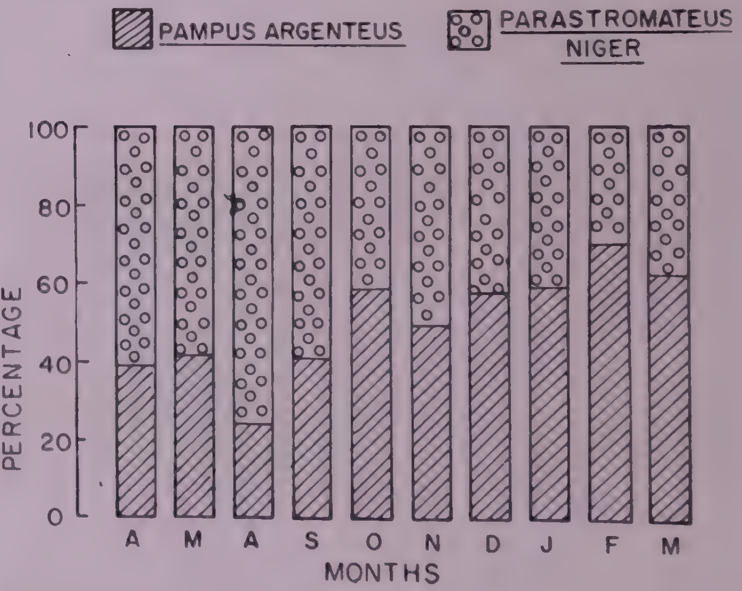

Fig. 41. Month-wise species composition of pomfrets in gill net catch.

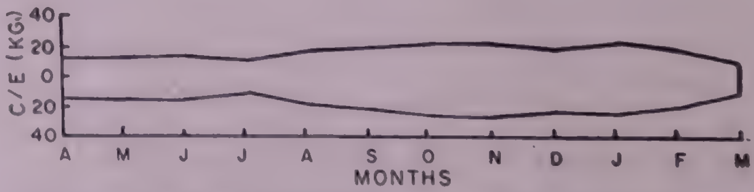

Fig. 42. Seasonal abundance of pomfrets in trawl net catch.

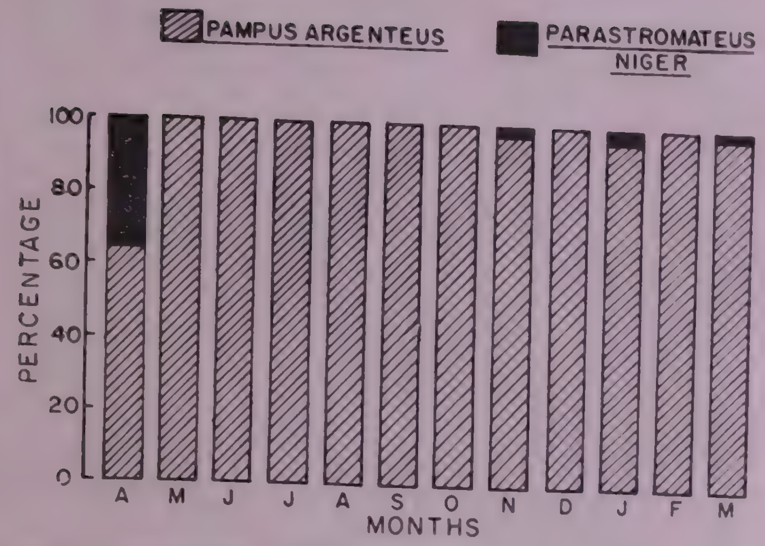

Fig. 43. Month-wise species composition of pomfrets in trawl net catch.

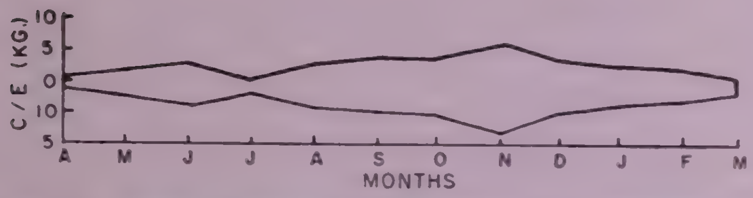

Fig. 44. Seasonal abundance of black pomfret *(P. argenteus)* in dol net catch.

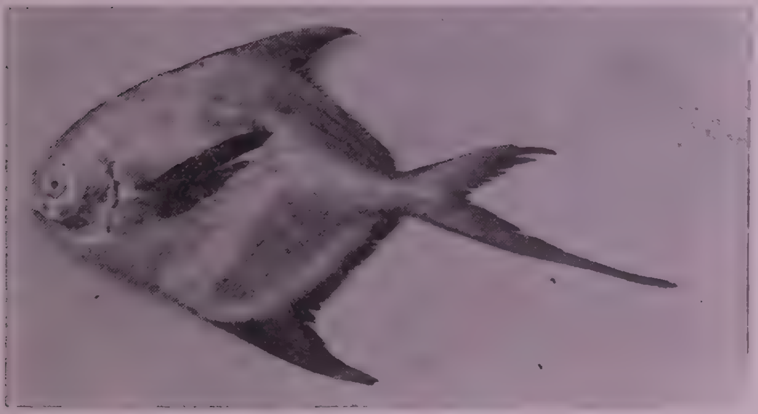

Fig. 45. *Pampus argenteus.*

Scientific Name : *Pampus argenteus*
Vernacular Name : 'Saranga'/'Paplet'
Gear : Trawl net/Gill net/Dol net
Percentage in the catch of the group : Trawl net : 97.4
Gill net : 49.7
Peak period of occurrence : Aug. – May
Depth of occurrence : 10 – 90 m
Length range in commercial fishery : 40 – 320 mm
Size at first maturity : 220 - 240 mm
Spawning season : Aug. – Sep. and Jan. – Mar.

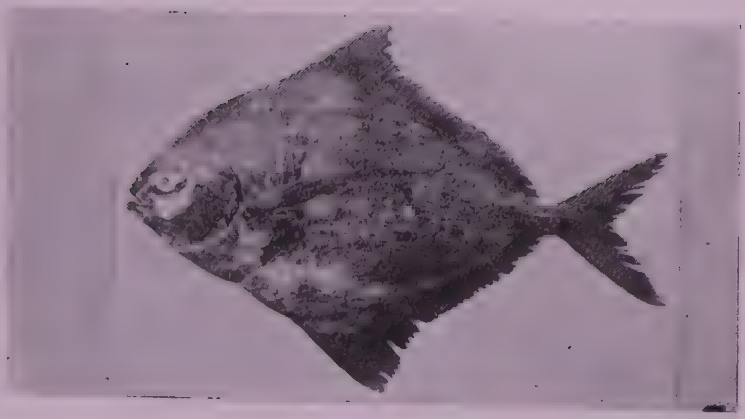

Fig. 46. *Parastromateus niger.*

Scientific Name : *Parastromateus niger*
Vernacular Name : 'Halwa'
Gear : Trawl net/Gill net
Percentage in the catch of the group · Trawl net : 2.6
Gill net : 50.3
Peak period of occurrence : Aug. – May
Depth of occurrence : 30 – 90 m
Length range in commercial fishery : 150 – 500 mm
Size at first maturity : —
Spawning season : —

SYNODONTIDAE

Popular English Name : Lizard fish
Vernacular Name (Marathi) : 'Chor bombil'
Annual average catch : 668 t
Percentage in total catch : 5.3
Fishing methods and their contribution : Trawl net: —

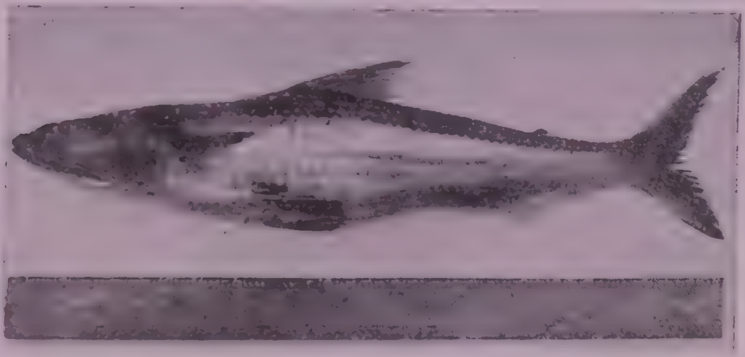

Fig. 47. *Saurida tumbil.*

Scientific Name . *Saurida tumbil*
Vernacular Name : 'Chor bombil'
Gear : Trawl net
Percentage in the catch of the group : —

Peak period of occurrence : Oct. – Nov.
Depth of occurrence : 60 – 90 m
Length range in commercial fishery : 210 – 540 mm
Size at first maturity : —
Spawning season : —

TACHYSURIDAE

Popular English Name : Cat fish
Vernacular Name (Marathi) : 'Singhala'
Annual average catch : 1,530 t
Percentage in total catch : 12.0
Fishing methods and their contribution : Trawl net : —

TRICHIURIDAE

Popular English Name : Ribbon fish
Vernacular Name (Marathi) : 'Wakti'/'Wagti'
Annual average catch : 1,087 t
Percentage in total catch : 8.5
Fishing methods and their contribution : Trawl net/ Dol net: —

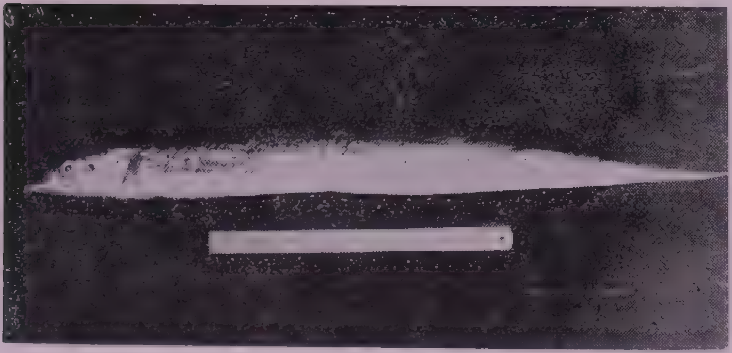

Fig. 48. *Trichiurus lepturus.*

Scientific Name : *Trichiurus lepturus*
Vernacular Name : 'Wakti'
Gear : Trawl net/Dol net
Percentage in the catch of the group : —
Peak period of occurrence : Oct. – Dec.
Depth of occurrence : 60 – 90 m
Length range in commercial fishery : 410 – 950 mm
Size at first maturity : —
Spawning season : Jun. – Jul.

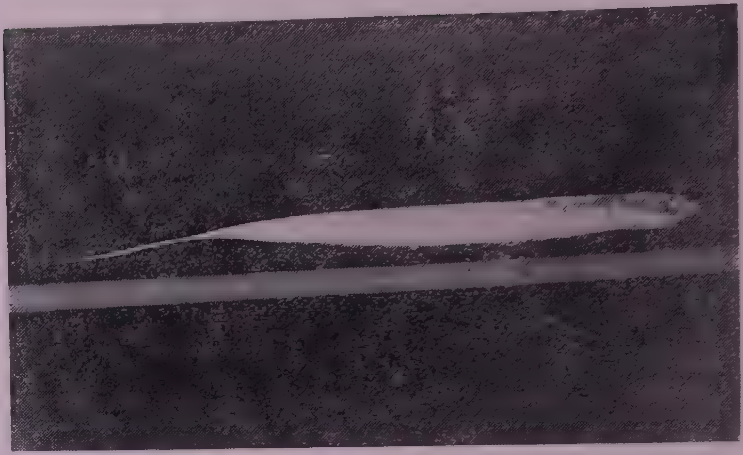

Fig. 49. *Eupleurogrammus muticus.*

Scientific Name : *Eupleurogrammus muticus*
Vernacular Name : 'Wagti'
Gear : Dol net
Percentage in the catch of the group : —
Peak period of occurrence : Jul. – Sep.
Depth of occurrence : 10 – 30 m
Length range in commercial fishery : 250 – 400 mm
Size at first maturity : —
Spawning season : Feb. – May

XIPHIDAE

Popular English Name : Sword fish
Vernacular Name (Marathi) : 'Ghoda'
Annual average catch : 115 t
Percentage in total catch : 0.9
Fishing methods and their contribution : Gill net: —

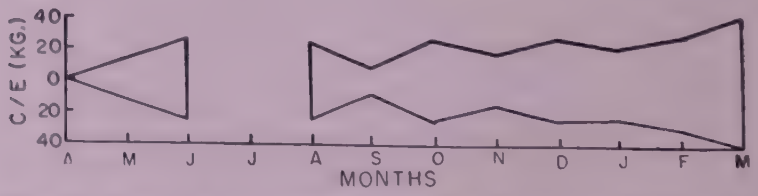

Fig. 50. Seasonal abundance of sword fish (Xiphiidae) in gill net catch.

PSYCHO-SOCIAL ASPECTS OF FISHERMEN WITH RESPECT TO MOTORIZATION

Krishna Srinath
Central Marine Fisheries Research Institute, Cochin

In India the motorization of country crafts has, to a certain extent, helped the fishermen to increase their fish catch as a result of the increased mobility and the access to the fishing grounds. It has been reported that in Kanyakumari, due to motorization the employment opportunity had doubled as more number of fishermen were required to go in the craft. An increase by six times in the gross returns of fishermen after motorization has also been reported. Though the economic benefits of this innovation was quite perceivable its popularization has not been quite even. For example in Kerala, while fishermen of Alleppey and Quilon adopted motorization prior to 1980, the fishermen of Kannamali and Saudi areas in Cochin took up the same during 1981–'83. The innovation caught up in Vypeenkara during 1984–'85 only. The number of motorized units in Vypeenkara during 1982 was only one or two and in 1985 it was about 115. Though the causative factor for adoption of this innovation is primarily better returns in economic terms, its continuance and sustenance as well as adoption of more improved fishing methods will, to a great extent, depend on the impact of this innovation on the social well–being of the fishermen. This report examines the efficiency of the technology based on the perception of fishermen of their present and future status in relation to their living conditions prior to motorization. The study was conducted in Vypeenkara during August-October 1985.

Out of about 115 motorized country crafts, the owners/shareholders of 50 units were subjected to the study. Data were collected using an interview schedule involving projective and non projective techniques. Information on personal variables, impact of motorization and the living standards and projection for future, aspirations and facility satisfaction as assessed qualitatively by fishermen themselves were collected.

Age and education of the respondents

The respondents were in the age range of 18–58. About 35% was in the age group of 18–30, 37% in the age group of 31–45 and 28% in the age group of 46–58. The educational status of the respondents was between II–IX standard. Twenty per cent of the respondents had educational status between I & IV standard. The age-wise and education-wise distribution of respondents is given in Table 1.

Table 1. *Age and education of the respondents*

Age (years)	Education (figures indicate % respondents)			
	Below primary	Primary	Primary–secondary	Secondary
18–30	—	5.8	21.5	7.8
31–45	—	7.8	27.4	1.9
46–50	5.0	5.4	1.9	1.9
> 50	1.9	9.8	1.9	—
Total	6.9	28.8	52.7	11.6

Family structure

Eighty per cent of the respondents was having nuclear families and the rest had one or more numbers living with them, the average family size being 6.5.

Table 2. *Details of crafts & gears used by the motorized units*

Type	Crafts (% respondents)	Type	Gear (% respondents)
Small	—	Drift gillnet	29.4
Medium	50.9	Boat seine (combination)	31.4
Big	49.1	Hooks & line	19.6
		Boat seine, Drift gillnet & Hooks & line	19.6
		Drift gillnet & Boat seine	—

Occupation

Ninety per cent of the respondents was engaged in traditional fishing before taking up motorized fishing and 10% had occupations not related to fisheries.

Details of crafts and gears owned

The details of crafts and gears belonging to the motorized units are given in Table 2. Among motorised units percentage of the canoes crewed by 16 and 5 was about 50% each.

Source of inspiration for motorization

Eighty per cent of the respondents indicated their source of inspiration for taking up motorization as the demonstration effect of fishermen of Kannamali, Saudi and Alleppey. Fifteen per cent indicated that availability of credit under IRDP was the factor which prompted them to go in for motorization and the rest of them have followed their fellow fishermen in the adoption of the innovations.

Source of finance

About 59% of the respondents had availed individual loan facilities available for purchase of country crafts under IRDP and pooled them together to purchase the motorized units. About 12% had availed credit scheme by Latin Catholic Church and 29% had made use of their own resources. The time lag between their desire to have motorized units and actual possession ranged between 4 months to 4 years. Regarding the difficulties encountered in realizing the goal, loss of fishing days and travelling and miscellaneous expenditure were indicated as most important (Table 3).

Table 3. *Source of credit, time taken and difficulties in realising the goal (in %)*

Source of credit	Respondents (%)	Time taken (years)	Respondents (%)	Difficulties encountered (Multi-responses)	Respondents (%)
IRDP	58.8	About 1	25.0	Loss of fishing days	74.5
Latin Catholic Church	11.8	2–3	70.8	Extra expenditure including travel	50.0
Own resources	29.4	3–4	4.2	—	—

Impact of motorization as perceived by the respondents

All respondents in this study agreed that there was some increase in their income as the result of motorization. The number of fishing days have gone down as Sundays had become compulsory holidays. Ninety per cent had already registered definite increase in the quantity of fish caught. No change was seen in the role of women in the post harvest operations or their income. Eighty per cent of the respondents reported improvement in their food consumption and 70% said that the clothing had improved. No change was immediately perceivable in education and housing, but many of them hoped that there would be improvement in these aspects in the next five years. The saving habit of 8% of the respondents already indicated improvement. Seven items pertaining to socio-economic conditions were presented to the respondents on a five point scale and the mean score obtained indicated improvement in the overall socio-economic conditions. The details are presented in Table 4.

Table 4. *Socio-economic changes after motorization as perceived by respondents*

Parameters administered (Multi-responses)	Respondents (%)	Mean score (maximum score = 5)
Increase in mobility	100	4.53
Increase in catch	100	4.64
Improvement in food	80	4.82
Improvement in clothing	70*	3.22
Improvement in housing	43*	3.87
Improvement in education of children	96*	3.90
Improvement in savings	8	2.55
		pooled 3.93

* Hope to improve soon.

Facility satisfaction

Six aspects of facilities related to the operation and maintenance of motorized units and disposal of catch namely landing facilities, market, availability of inputs like kerosene, petrol and engine oil, facilities for storing and repair of engine and finance were presented to the respondents on a five-point scale. The scores are presented in Table 5. The mean facility satisfaction score was 2.2 which was below satisfactory. It was reported that the 600 litres of kerosene available to them through government outlets for a period of one month was sufficient only for 20 days and the rest of the quantity had to be bought from the open market at prices prevailing at that time. Regarding marketing of the catch the time of landing was reported to determine the trade. If agents could get sufficient quantity of fish from Cochin Fisheries Harbour, the price of fish landed at Vypeen was reported to go down. The landing facilities at Vypeen was felt to be unsatisfactory. The facilities for storing the engines were also not satisfactory. For repairing engines no facility was available in the Island and the fishermen had to go out of the Island even for every small repair, paying exhorbitant charges for private conveyance.

Table 5. *Facility satisfaction mean score*

Facilities considered	Mean score (maximum score = 5)
Landing facility	2
Marketing	3
Inputs for operating the engine	2
Storage facility for engine	2
Repair	1
Finance	2
	pooled 2.20

Aspirations

Aspiration was measured for education and occupation for children, food, clothing, housing and ownership of fishing implements and the rank order is presented in Table 6. Eighty two per cent considered better living in terms of food, shelter and clothing as most important while 63% considered ownership of fishing implements and more number of crafts and gears and 63% better education for their children.

Table 6. *Aspirations and ratings for self*

Aspirations	Rank order (%) (multiresponse)	Rating for time dimensions	Self mean rating
Better living in terms of food, shelter & clothing	82	Past	1.0980^{a} (0.3003)
Education for children	63	Present	2.8627^{b} (0.6331)
Possession of implements	63	Future	6.2941^{c} (0.9848)

Note: Means with different superscripts differ significantly among themselves at 1% level of significance.

Rating for self and village

A ten point ladder scale (0–10) indicating progress in life was administered to the respondents. Their assessment of general conditions and extent of progress as subjectively perceived for self for three time dimensions namely past, present and future at the interval of five years was rated. The mean rating is given in Table 6. The rating for past, present and future aspirations showed significant difference which indicated that the change brought about by motorization was significant. As regards rating for village, an open question was put asking whether the respondent thought that motorization had brought about any improvement in the life of the villagers or whether they perceived any change in future. Seventy per cent felt that the villagers can progress if they go in for motorization at large as some progress has been indicated in the first year of motorization.

Conclusion

During 1982–'83, though fishermen of Vypeen Island were aware of motorization the factor which hindered the adoption was lack of financial resources. Though schemes were available under IRDP for motorization of fishing crafts the initial investment of Rs. 9,000/- was beyond the reach of small fishermen. As they realised the benefits of motorization from the successful experience of the fishermen elsewhere they had availed the credit available under different agencies for purchase of motorised units. They felt that the motorization has already proved its worth and if it continues to accrue more benefits they may switch over to mechanised fishing by raising pooled capital. When they were asked to react to the banning of mechanised fishing like trawling and purse-seining the general feeling was that mechanization was not totally harmful to them. This was mainly due to the increased mobility of motorized units and the resultant increase in catch.

From the above findings it may be concluded that motorization can be instrumental in bringing about significant changes in the living conditions of fishermen and their outlook and inculcating the spirit of unity and co-operation among them. The fishermen in general felt that their status has improved as a result of motorization and were more optimistic about their future. It is hoped that proper motivation and facilities with adequate supporting services will lead to quicker adoption of better fishing methods.

REPORT ON A DIAMOND-BACK SQUID CAUGHT OFF VERAVAL, GUJARAT*

During the course of survey, a male specimen of 'Diamond-back squid' *Thysanotenthis rhombus* weighing 1.65 kg was recorded from trawl landings at Veraval on 28-2-1987 (Fig. 1). The squid was caught by a trawler off Veraval at a depth of about 80 metres. The stomach was found to be empty. The body measurements (in mm) are as follows:

1.	Dorsal mantle length (DML)	327
2.	Ventral mantle length	323
3.	Mantle width	303
4.	Mantle width Index	92.6 % of DML
5.	Head length	67
6.	Head width index	23.32 % of DML
7.	Arm length	195
8.	Arm length index	59.63 % of DML
9.	Eye diameter	4.8
10.	Hetrocotylus length index	29.23 % of DML
11.	Sucker index (sessile)	1.83 % of DML
12.	Suckers	prominent 16 in left arm and prominent 23 in right arm.

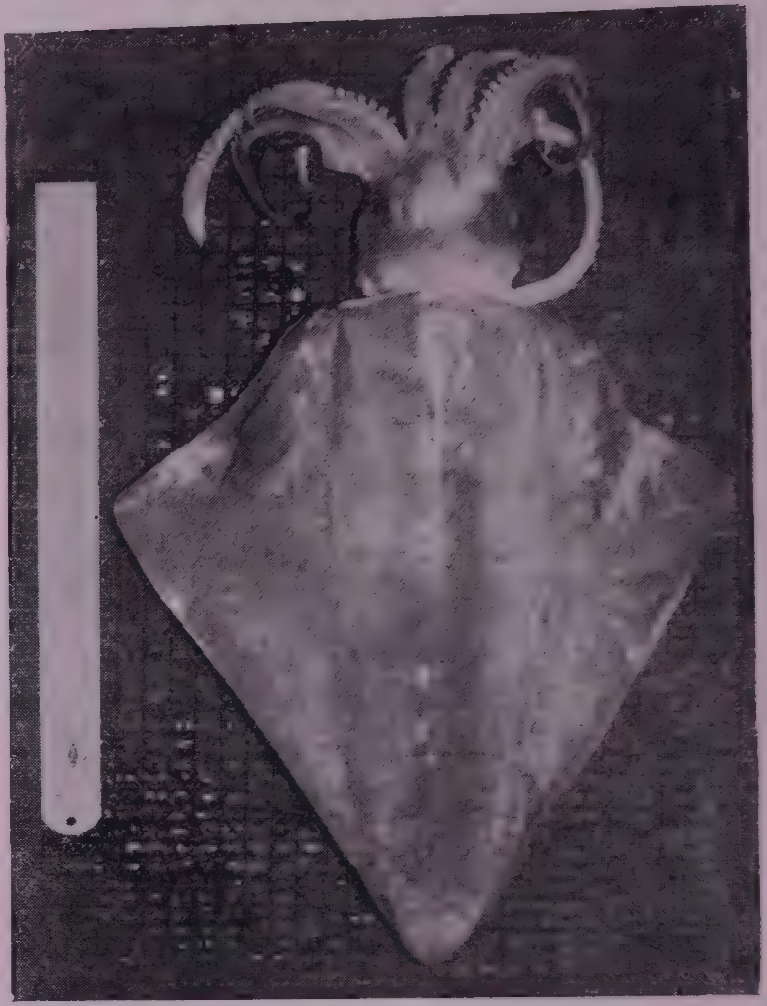

Fig. 1. Dorsal view of the Diamond-back squid.

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* Reported by A. P. Lipton, Veraval Research Centre of CMFRI, Veraval.

* * *

BUMPER CATCH OF 'KALARU' FROM DHANUSHKODI AND MOONDRURAYARCHATHIRAM (PALK BAY), RAMESWARAM ISLAND*

Five-spotted herring *Hilsa kelee* locally known as 'Kalaru' in Tamil occurs in small quantities in shore-seines ('Kara valai'), drift net ('Paru valai') and in bottom set gill net ('Disco valai') at Mandapam – Rameswaram region. In this area, the fishing season for the species extends from April to October in the Palk Bay and from November to March in the Gulf of Mannar. In the latter region the catch rate ranges from 5 to 30 kg per drift net unit. At Dhanushkodi, where relatively more intense fishing is observed, a catch rate of 380 kg per unit is obtained by the 'Kara valai'. In the bottom set gill net operated from this

Table 1. *Details showing the bumper catch of* Hilsa kelee

Date	Name of landing centre	No. of 'Kara-valai' units	Total catch in tonnes	Length range in (mm)	Dominant size in (mm)
7-4-'87	Moondrurayarchathiram	4	10.9	150–209	180–189
19-4-'87	-do-	1	36.0		
21-4-'87	-do-	1	5.0		
8-4-'87	Dhanushkodi	1	8.2	150–199	160–189
27-4-'87	-do-	1	1.5		
28-4-'87	-do-	3	4.75		

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* Reported by C. Kasinathan, Regional Centre of CMFRI, Mandapam Camp.

region, the catch rate of *Hilsa kelee* ranges from 1 to 5 kg per unit.

A bumper catch of *Hilsa kelee* was observed in the shore seines operated at the Palk Bay side at Dhanushkodi and Moondrurayarchathiram in the Rameswaram Island in April, 1987 and the details are presented in Table 1.

Mode of disposal of the catch

The offtake of fresh fish was found to be limited. The major portion of the catch was spread on the sandy beach and dried in the sun for 5 days, packed in gunny bags and sent to Nammakkal, Hyderabad and other places for preparing poultry feed. The price of fresh fish ranged from Rs. 1.50 to Rs. 2 per kg, and of the dried fish from Rs. 2.50 to Rs. 3 per kg.

UNUSUAL LANDING OF CAT FISH *TACHYSURUS DUSSUMIERI* AT MADRAS*

About 2,000 numbers of cat fish *Tachysurus dussumieri* weighing approximately five tonnes were landed on 25-11-1987 by shore seine operation at Nochikuppam landing centre in Madras. The entire catch was realised from a single operation which is an unusual phenomenon along Madras coast. The catch was sold for Rs. 30,000 at the landing centre itself.

A sample of 69 specimens of the fish was collected from the catch for biometric and biological observations. The total length ranged from 611–710 mm. The maximum frequency of 18.8% was observed in the length group of 651–660 mm. Of the 69 specimens, 46 were males (66.7%) and 23 were females (33.3%). All the females were in stage V of gonadial development.

Large shoals of cat fish are usually reported from the west coast. Recently, heavy landings of cat fish have been reported from the east coast also, especially at Pondicherry (bag net) and Mandapam (trawl net).

Spawning migration of *T. thalassinus* and *T. tenuispinis* towards shallow waters of less than 10 m depth has been reported during southwest monsoon (May – July) from the west coast. Considering the fact that all the female specimens analysed were in advanced stage of gonadial maturity, it appears that *T. dussumieri* also tends to migrate towards shallow waters during northeast monsoon (October – December) along the east coast.

Cat fish do not form a major fishery along the Madras coast. The annual average landing is about 2.9 tonnes from trawlers, 0.6 tonne from mechanised gill netters and 0.5 tonne from non-mechanised gill netters during 1980–'86. The present unusual heavy landing was observed for only one day and it was confirmed from the fishermen that the shoal was moving from south to north and that they could get only about 25% of the haul while the rest escaped.

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* Prepared by S. Srinivasarengan, Madras Research Centre of CMFRI, Madras.

The author names of Fish Calendar VI for Tuticorin (MFIS No. 84, June, 1988) may be read in the order S. Mahadevan, P. Sam Bennet, K. M. S. Ameer Hamsa, Pon. Siraimeetan and H. Mohamed Kasim. The name of Shri Pon. Siraimeetan was left out inadvertently during consolidation of the article.

—EDITORS

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Abbreviation – *Mar. Fish. Infor. Serv., T & E Ser.*, No. **90**: 1988

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3. Recent developments in prawn and fish culture in Andhra Pradesh

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Front cover photo:

A boat engaged in pole and line fishing for tuna at Minicoy.

Back cover photo:

Mechanised trawl landing centre at Rameswaram, Tamil Nadu.

MARINE FISH CALENDAR

XII. MANDAPAM*

P. Livingston, M. Sivadas and M. Badrudeen

Mandapam Regional Centre of CMFRI, Mandapam Camp

Introduction

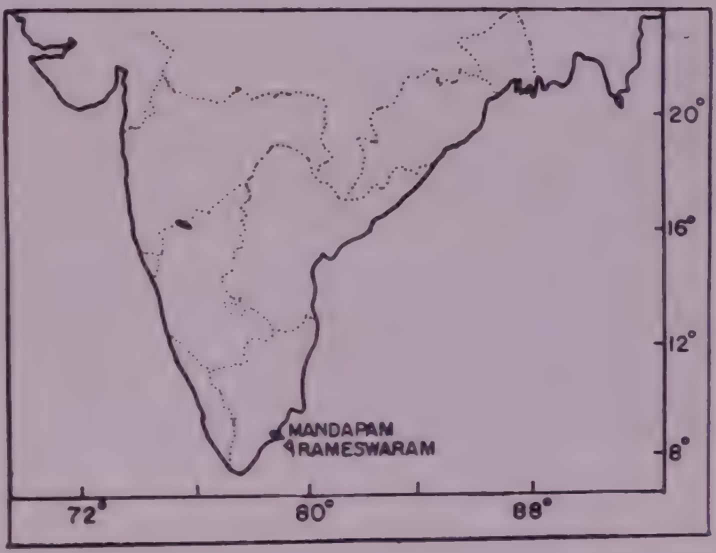
The Ramanathapuram District with a coastline of 261 km, covering the sea-front of Gulf of Mannar and Palk Bay, ranks foremost in marine fish production of Tamil Nadu State. Sustaining high levels of organic production, the seas along the coast have lucrative fishing grounds with greater profusion of finfishes, shellfishes, seaweeds and other economically important organisms. The fishery resources of the region in the fifties and sixties were mainly exploited by the indigenous crafts and gears in the near shore waters extending to a depth of 10–15 m. With the fishery technological advancement, and establishment of infrastructural facilities, the annual marine fish production of the District increased from 30,000 t to over 60,000 t during the past one and half decades.

Mechanised fishing boats are operated from 16 centres, majority of them being concentrated at Mandapam, Pamban and Rameswaram. Need-based berthing facilities for the mechanised fishing vessels and processing facilities are also available at these centres. The traditional crafts and gears are mainly operated in the other fish landing centres.

About 1,000 trawlers and over 5,000 non-mechanised boats are employed in the marine fisheries of this area. In recent years, several of the non-mechanised boats are fitted with either inboard or outboard engines.

Bottom trawl nets and the indigenous gears such as drift gill nets, hooks and lines, perch traps, shore-seines, fixed bagnets and other nets are employed in the fishery. In recent years several types of gears modified from the conventional basic gears are introduced into the fisheries of the region.

The fishing activities of the region are greatly influenced by the monsoon in the Palk Bay and Gulf of Mannar. During the southwest monsoon period (June–September) the fishery operations are greatly concentrated in the Palk Bay as it remains calm and offers favourable conditions. During the northeast monsoon (October-February), however, the fishing activities are shifted to the Gulf of Mannar region as the sea on the Palk Bay side gets rough. The Gulf of Mannar is open and deeper as compared to Palk Bay. The inshore region of the Gulf of Mannar (5–25 m depth) is beset with rocky patches with intervening sand and mud flats while that of Palk Bay (5–15 m depth), is mostly muddy.



Over 12 important groups of fishes constitute the commercial fisheries of Mandapam and Rameswaram region. The most important of these are: silver bellies, elasmobranchs, croakers, clupeids, goat fishes, perches, cat fishes, lizard fishes and carangids. At Mandapam, the annual fish production by trawlers fluctuated between 2,533 t in 1980 and 7,218 t in 1984, the average catch being 5,557 t. Silver bellies (2,692 t) accounted for 48% of the total trawler catches. In the order of abundance, penaeid prawns ranked second forming 12% of the catch. Croakers and elasmobranchs contributed to the tune of

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*Consolidated by N. Gopinatha Menon and K. Balachandran, CMFRI, Cochin.

270 and 240 t, respectively, the percentage composition of the group being 4–5% of the total yield of fish from the centre. Goat fishes, carangids, cat fishes, flat fishes, clupeids and other miscellaneous fishes together accounted for about 1,700 t (30%).

Although a few gill netters were operating at Rameswaram in 1981 and 1982, the principal units operated at present are the trawlers. The annual fish landing of the centre was seen fluctuating from 14,378 t in 1980 to 28,836 t in 1983 with the average registering at 22,065 t. Here also, silver bellies form the major group exploited, contributing to over 51% of the total trawler catch. The annual yield of silver bellies showed great fluctuations from 7,474 t to 14,800 t, during 1980-1984 period. The other important group of fishes exploited at the centre are elasmobranchs (2,933 t; 13.3%), croakers (2,000 t; 9.5%) and penaeid prawns (2,067 t; 9.4%). The other groups of fishes constituting the catch comprise mainly of goat fish, carangid, cat fish, flat fish, clupeid, cephalopod and crab. Those together contributed to an average of 3,660 t (16.6%) in the total catch.

The indigenous gears operating from Mandapam and Rameswaram centres catch, by and large, fishes from the pelagic and columnar regions. The important groups of fishes exploited in this sector are clupeids formed by *Sardinella albella, S. gibbosa,* mackerel and carangids. Anchovies and seer fishes support to a seasonal fishery in this region. The annual production of these fishes, as observed elsewhere in the coast have shown wide fluctuation.

The fish calendar of Mandapam–Rameswaram presented in this report deals with elasmobranchs, silver bellies, carangids, mackerel and perches which form the main constituents of the commercially exploited fishes of the region.

CARANGIDAE

Popular English Name	: Horse mackerel/ Scads/Leather jackets
Vernacular Name (Tamil)	: 'Parai'
Annual average catch	: 128 t
Percentage in total catch	: 42
Fishing methods and their contribution	: Trawl net : 2% Shore seine : 40%

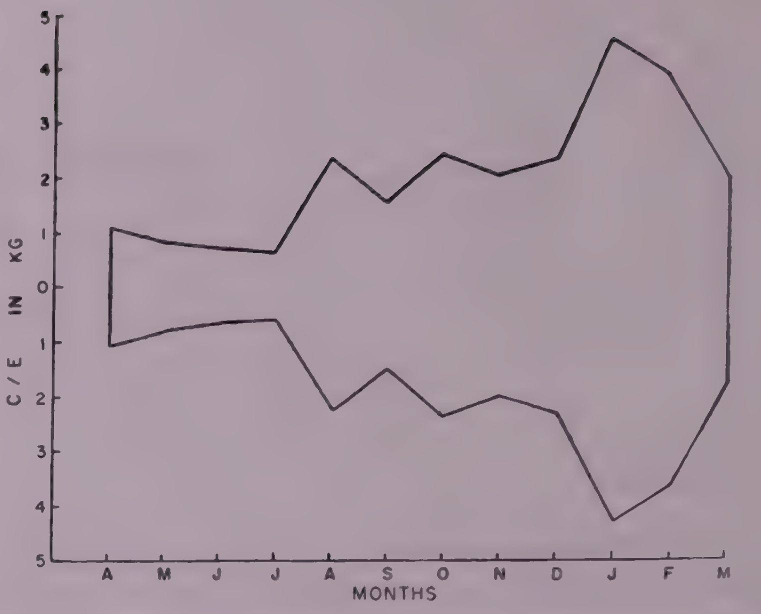

Fig. 1. Seasonal abundance of carangids in the trawling grounds

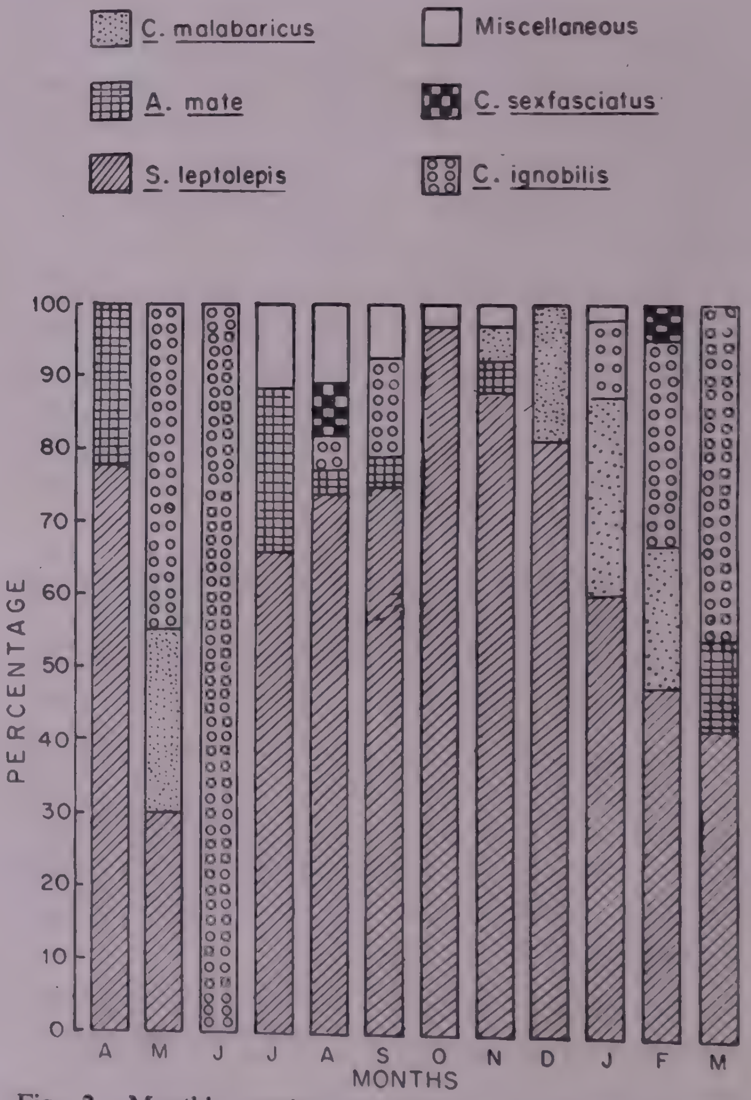

Fig. 2. Monthly species composition of carangids landed by trawlers.

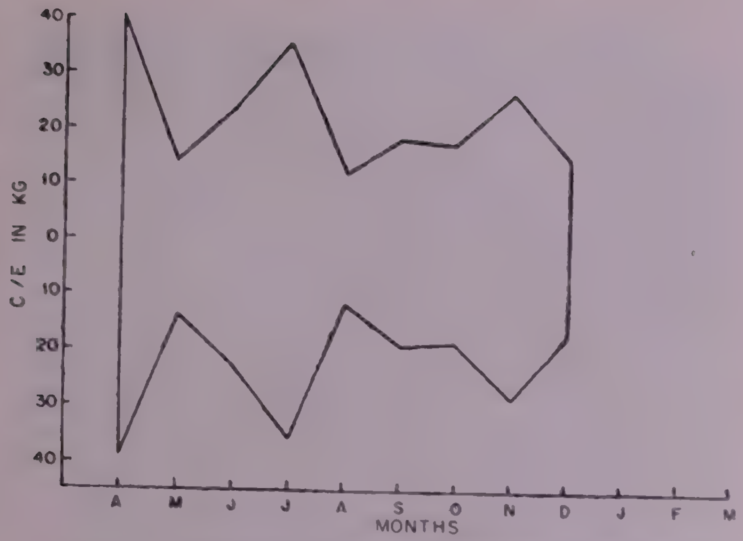

Fig. 3. Seasonal abundance of carangids in the inshore waters.

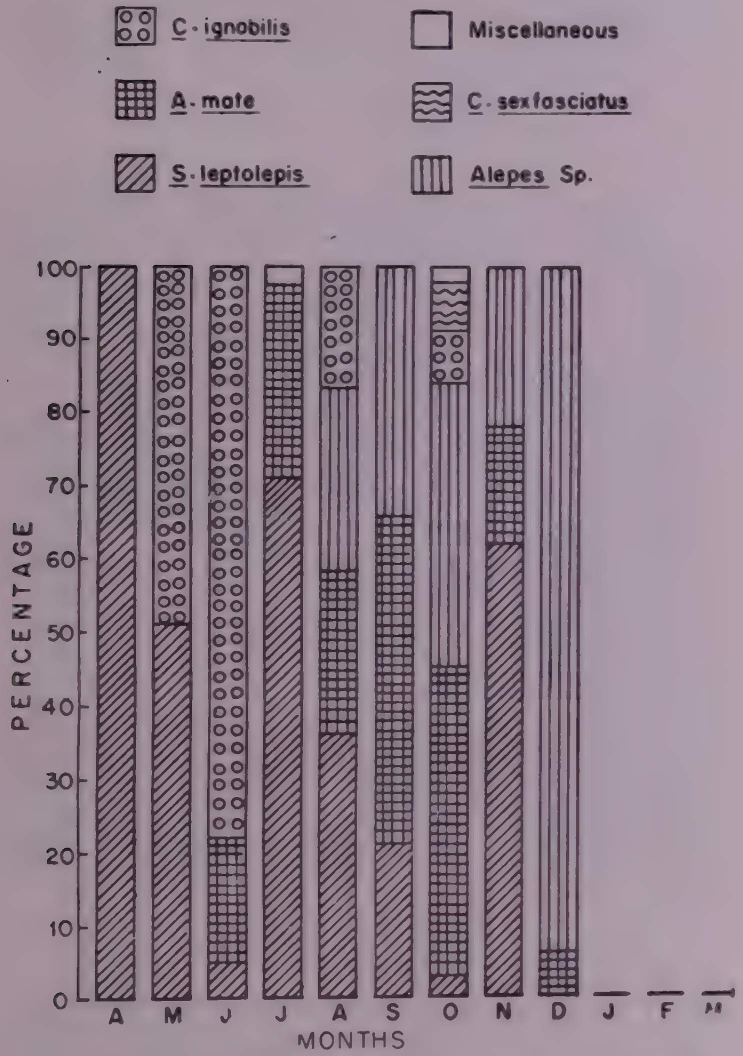

Fig. 4. Monthly species composition of carangids landed by shore seine.

ELASMOBRANCHS

Popular English Name : Sharks/Rays/Skates
Vernacular Name (Tamil) : 'Surah'/'Thirukai'
Annual average catch : 2,689.7 t
Percentage in total catch : 4.79

Gear-wise annual average catch : Trawl net : 1,896.6 t
Gill net : 765.9 t
Hooks & line : 27.2t

Fishing methods and their contribution : Trawl net : 70.50 %
Gill net : 28.48 %
Hooks & line: 1.01 %

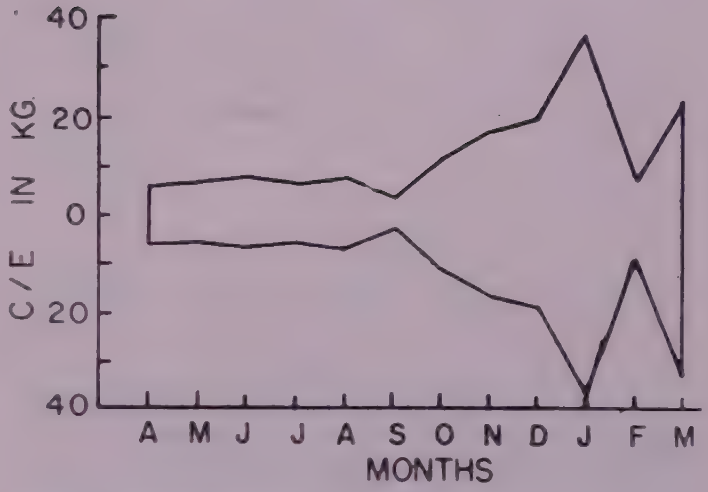

Fig. 5. Seasonal abundance of elasmobranchs in trawl nets.

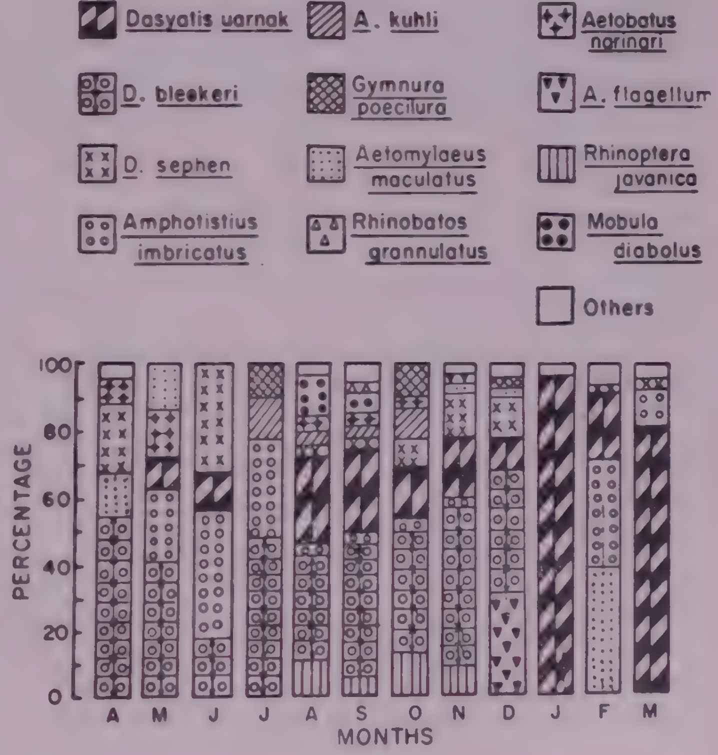

Fig. 6. Monthly species composition of elasmobranchs in trawl nets.

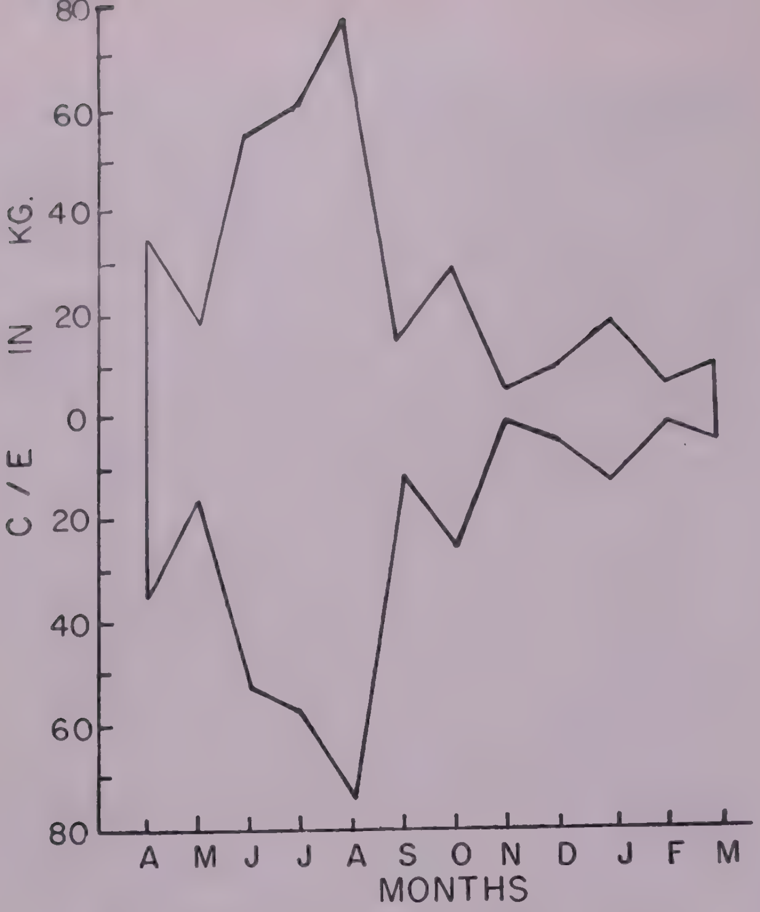

Fig. 7. Seasonal abundance of sharks in gill nets.

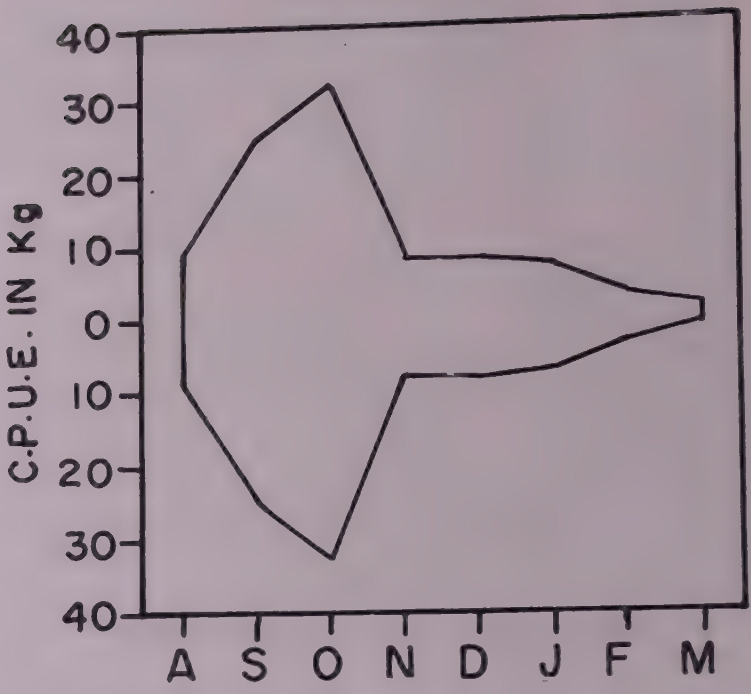

Fig. 9. Seasonal abundance of sharks in hooks and line.

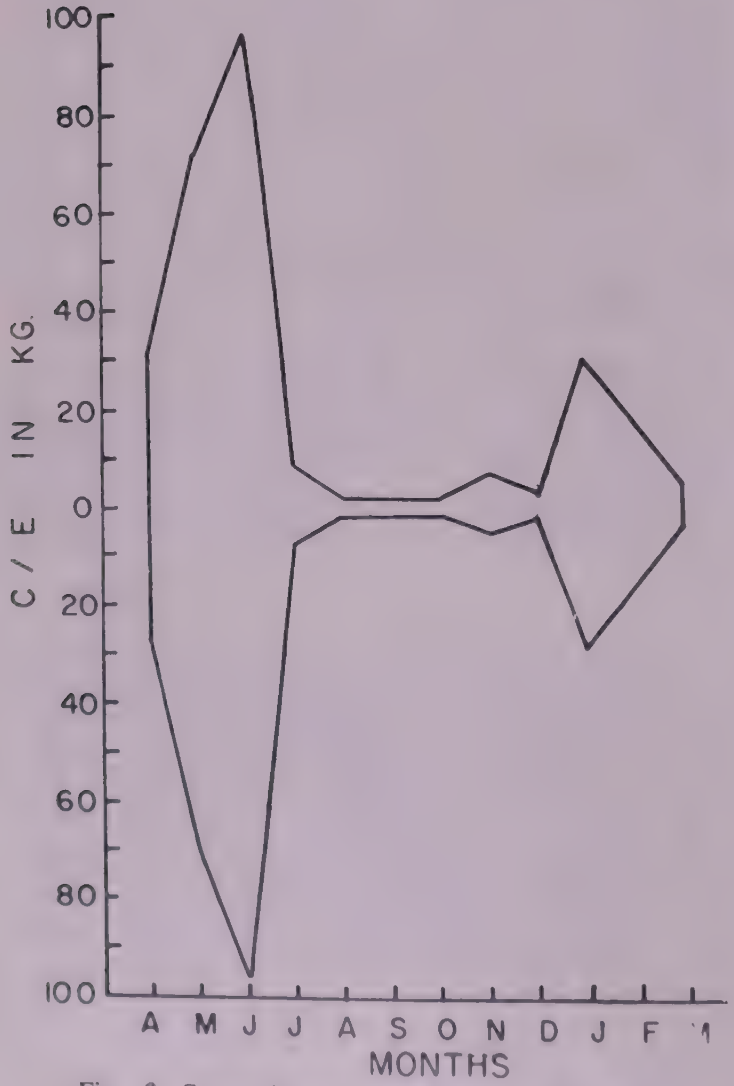

Fig. 8. Seasonal abundance of rays in gill nets.

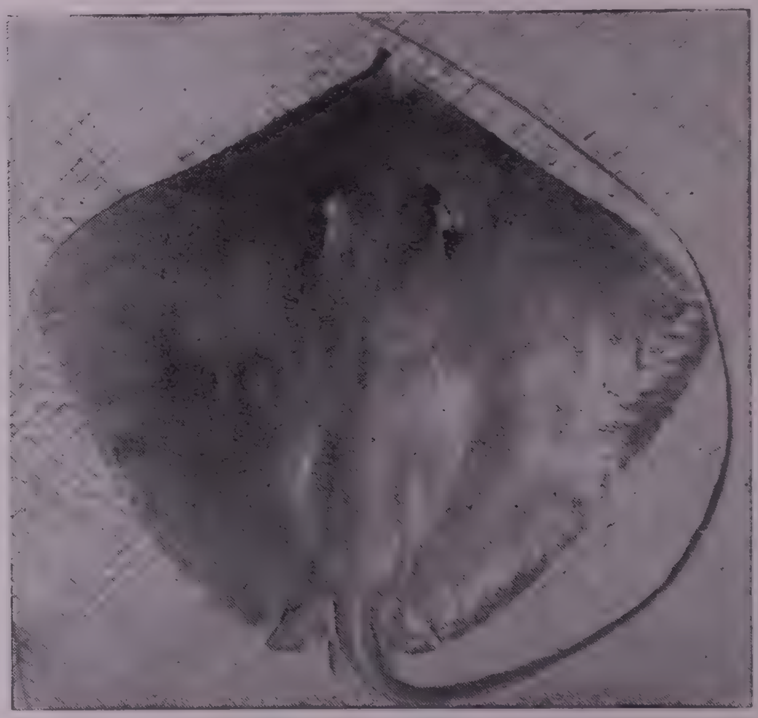

Fig. 10. *Dasyatis bleekeri.*

Scientific Name : *Dasyatis bleekeri*
Vernacular Name : 'Manal thirukai'
Gear : Trawl net
Percentage composition in the gear : Trawl net : 28.3
Peak period of occurrence : Mar. – Dec.
Depth of occurrence : 10 - 20 m
Length range in commercial fishery : 145 – 1,060 mm
Size at first maturity : 670 mm
Spawning season : Apr. and Sep.

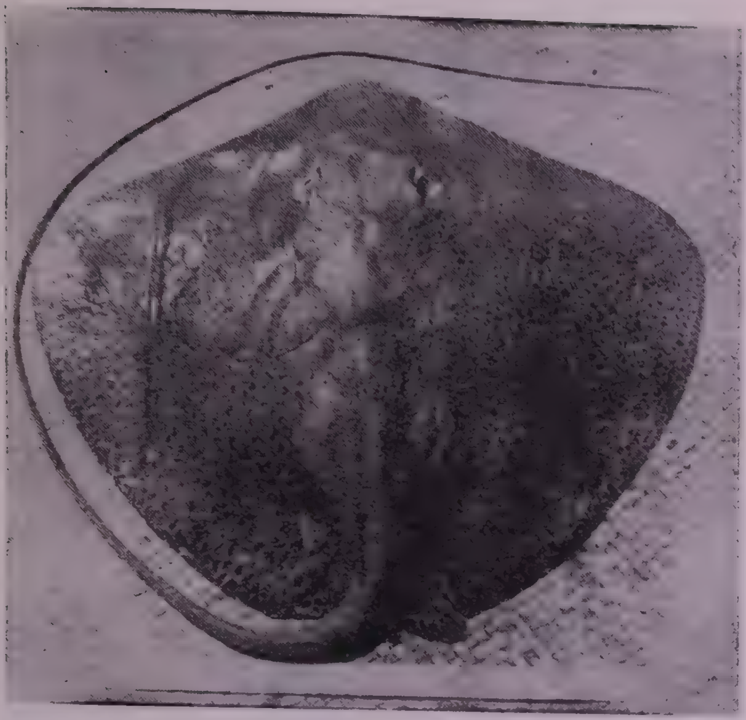

Fig. 11. *Dasyatis uarnak.*

Scientific Name : *Dasyatis uarnak*
Vernacular Name : 'Puliyan thirukai'
Gear : Trawl net
Percentage composition in the gear : Trawl net : 27.1
Peak period of occurrence : Aug. – Mar.
Depth of occurrence : 10 – 20 m
Length range in commercial fishery : 215 - 1,200 mm
Size at first maturity : 760 mm
Spawning season : Dec. and Jul.

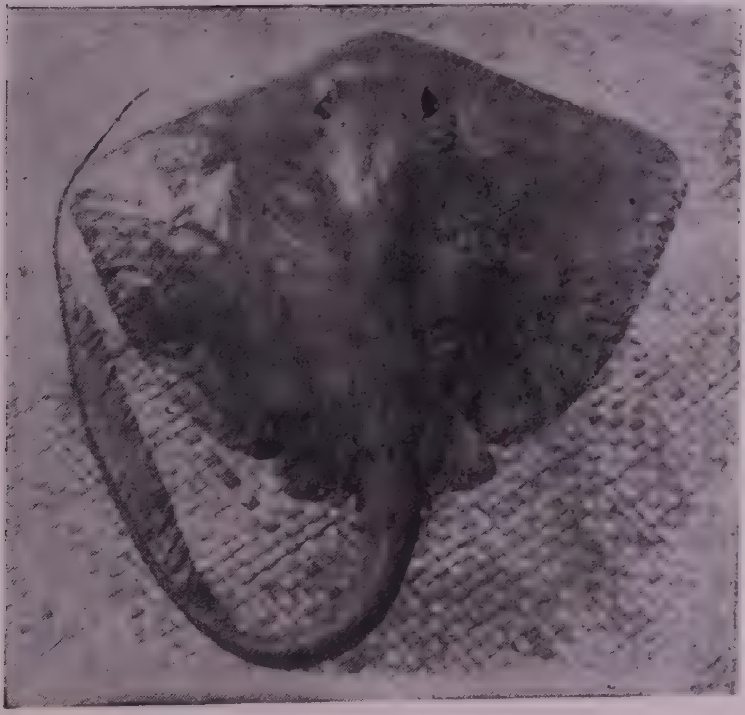

Fig. 12. *Dasyatis sephen.*

Scientific Name : *Dasyatis sephen*
Vernacular Name : 'Auda thirukai'
Gear : Trawl net
Percentage composition in the gear : Trawl net : 10.12
Peak period of occurrence : Apr. – Jun. and Oct. – Dec.
Depth of occurrence : 10 – 20 m
Length range in commercial fishery : 180 – 1,460 mm
Size at first maturity : 660 mm
Spawning season : Dec. – Jan.

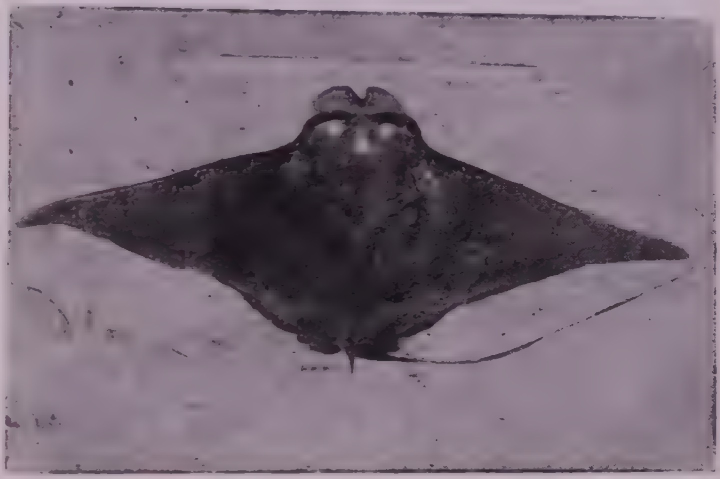

Fig. 13. *Rhinoptera javanica.*

Scientific Name : *Rhinoptera javanica*
Vernacular Name : 'Valvadi thirukai'
Gear : Trawl net
Percentage composition in the gear : Trawl net : 3.33
Peak period of occurrence : Aug. – Nov.
Depth of occurrence : 10 – 20 m
Length range in commercial fishery : 480 - 1,500 mm
Size at first maturity : 540 mm
Spawning season : Jan. – Feb.

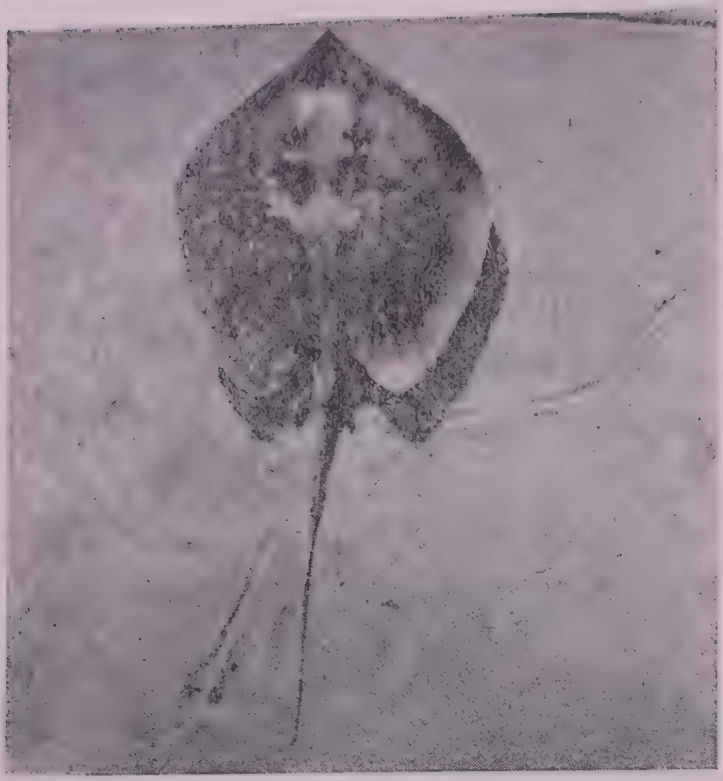

Fig. 14. *Amphotistius imbricatus*.

Scientific Name	:	*Amphotistius imbricatus*
Vernacular Name	:	'Senthirukai'
Gear	:	Trawl net
Percentage composition in the gear	:	Trawl net : 14.14
Peak period of occurrence	:	Feb. – Jul.
Depth of occurrence	:	10 – 20m
Length range in commercial fishery	:	140 – 249 mm
Size at first maturity	:	180 mm
Spawning season	:	Throughout the year

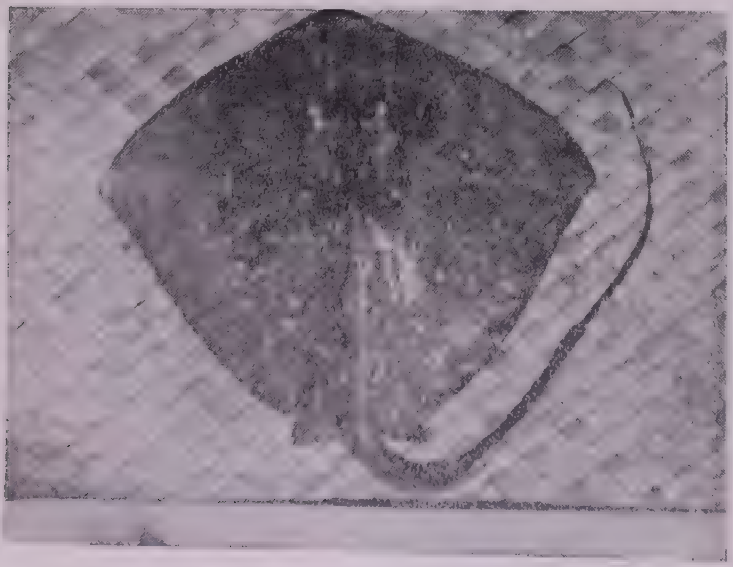

Fig. 15. *Amphotistius kuhli*.

Scientific Name	:	*Amphotistius kuhli*
Vernacular Name	:	'Katti Thirukai'
Gear	:	Trawl net
Percentage composition in the gear	:	Trawl net : 2.55
Peak period of occurrence	:	Aug. – Oct.
Depth of occurrence	:	10 – 20 m
Length range in commercial fishery	:	120 – 339 mm
Size at first maturity	:	240 mm
Spawning season	:	Jan. – Apr.

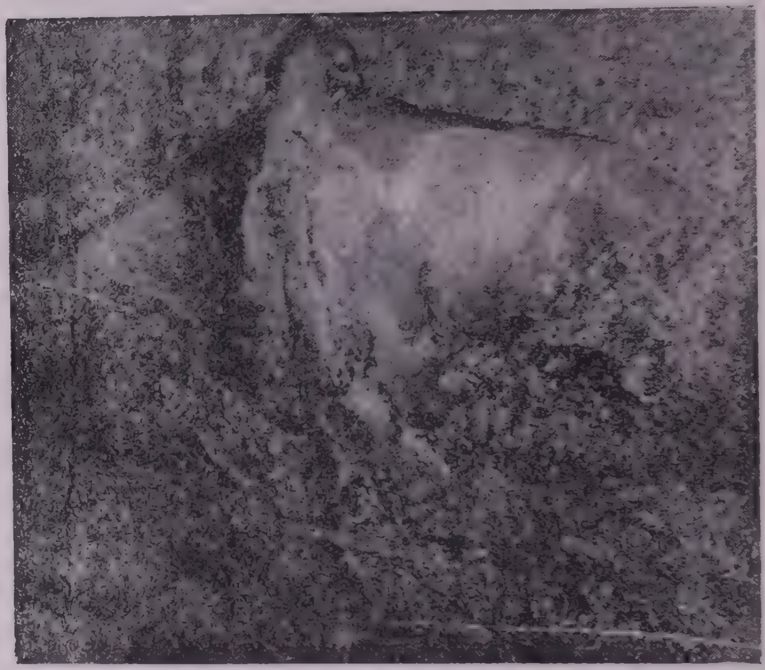

Fig. 16. *Aetobatus narinari*.

Scientific Name	:	*Aetobatus narinari*
Vernacular Name	:	'Kuruvi thirukai'
Gear	:	Trawl net
Percentage composition in the gear	:	Trawl net : 3.33
Peak period of occurrence	:	Apr. – May and Aug. – Nov.
Depth of occurrence	:	10 – 20 m
Length range in commercial fishery	:	520 – 1,060 mm
Size at first maturity	:	740 mm
Spawning season	:	Nov.

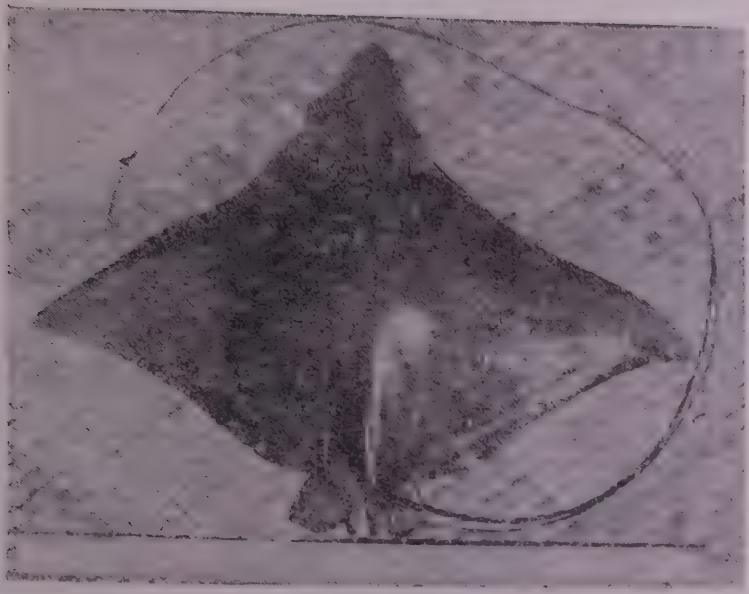

Fig. 17. *Aetobatus flagellum.*

Scientific Name	: *Aetobatus flagellum*
Vernacular Name	: 'Sanguvayan thirukai'
Gear	: Trawl net
Percentage composition in the gear	: Trawl net : 2.81
Peak period of occurrence	: Nov. – Dec.
Depth of occurrence	: 10 – 20 m
Length range in commercial fishery	: 420 – 1,300 mm
Size at first maturity	: 860 mm
Spawning season	: Mar. – Apr.

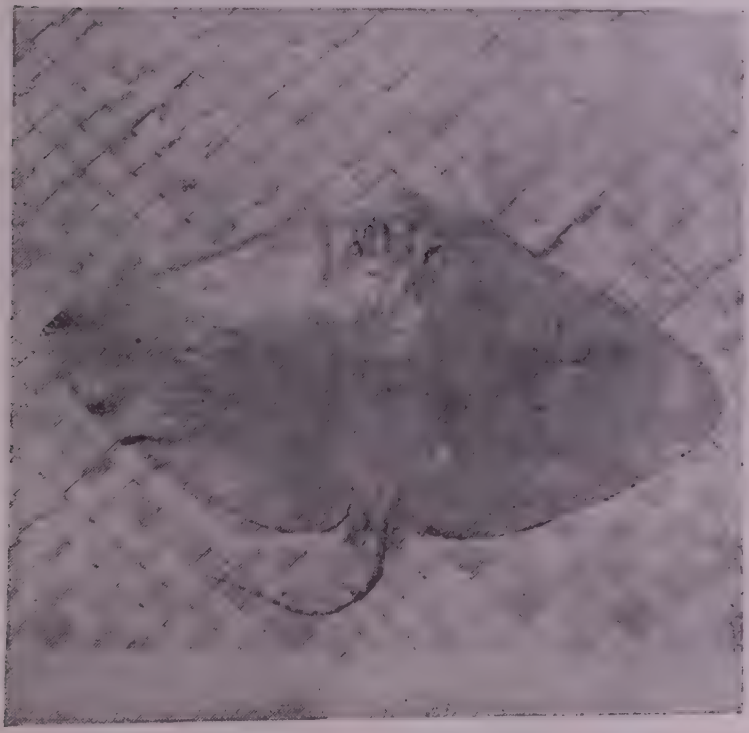

Fig. 18. *Gymnura poecilura.*

Scientific Name	: *Gymnura poecilura*
Vernacular Name	: 'Atuvani thirukai'
Gear	: Trawl net
Percentage composition in the gear	: Trawl net : 2.24
Peak period of occurrence	: Jul. and Oct.
Depth of occurrence	: 10 – 20 m
Length range in commercial fishery	: 240 – 960 mm
Size at first maturity	: 570 m
Spawning season	: Mar. and Sep.

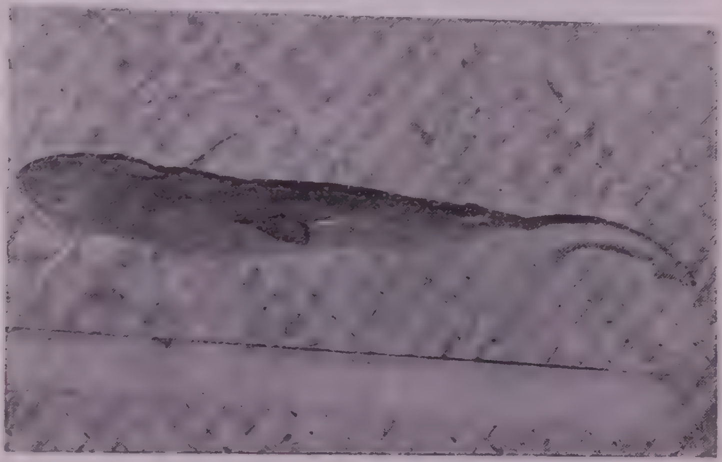

Fig. 19. *Scoliodon palasorrah.*

Scientific Name	: *Scoliodon palusorrah*
Vernacular Name	: 'Pal chura'
Gear	: Gill net/Hooks and line/Trawl net
Percentage composition in the gear	: Gill net : 10.0 Hooks & line : 4.0 Trawl net : 0.5
Peak period of occurrence	: Apr. – Oct.
Depth of occurrence	: 10 – 40 m
Length range in commercial fishery	: 220 – 1,500 mm
Size at first maturity	: 1,285 mm
Spawning season	: Apr.

LEIOGNATHIDAE

Popular English Name	: Silver bellies
Vernacular Name (Tamil)	: 'Kaaral'
Annual average catch	: 14,720 t
Gear-wise annual average catch	: Shore seine : 5 t Trawl net : 14,715 t
Fishing methods and their contribution	: Shore seine : — Trawl net : 70%

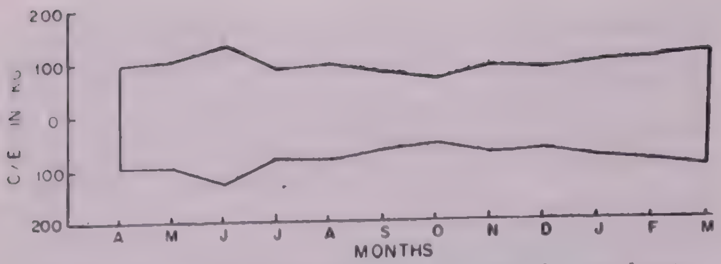

Fig. 20. Seasonal abundance of silver bellies by trawl nets.

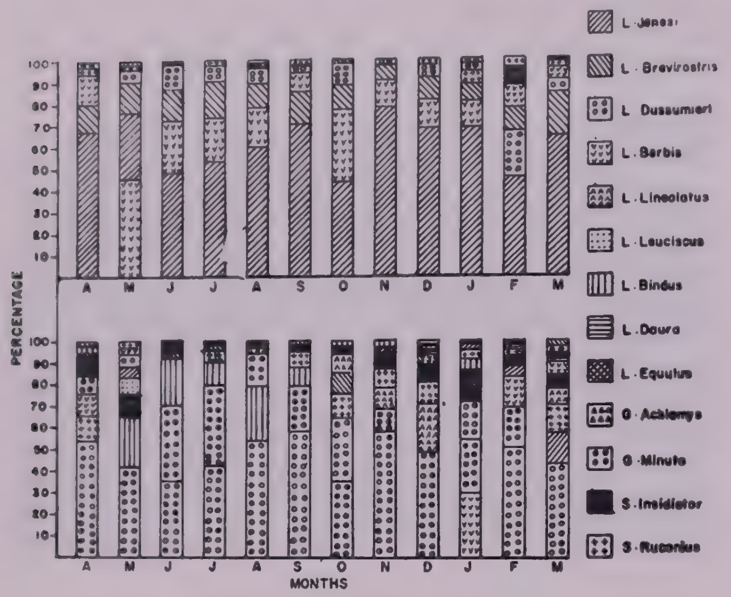

Fig. 21. Monthly species composition of silver bellies landed by trawl nets (upper panel – Palk Bay, lower panel - Gulf of Mannar)

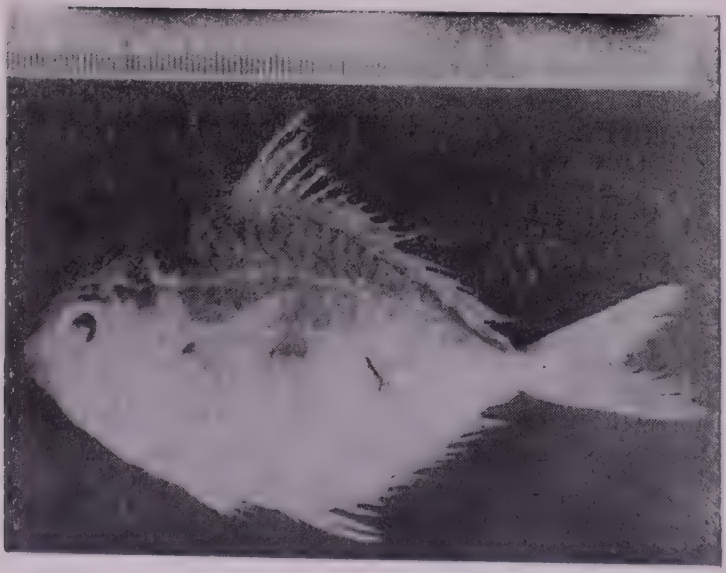

Fig. 22. *Leiognathus jonesi*

Scientific Name	:	*Leiognathus jonesi*
Vernacular Name	:	'Saluvatti kaaral'
Gear	:	Trawl net/ Shore seine
Peak period of occurrence	:	Throughout the year
Depth of occurrence	:	5 - 20 m
Length range in commercial fishery	:	35 – 95 mm
Size at first maturity	:	Males : 70 mm Females : 65 mm
Spawning season	:	Throughout the year

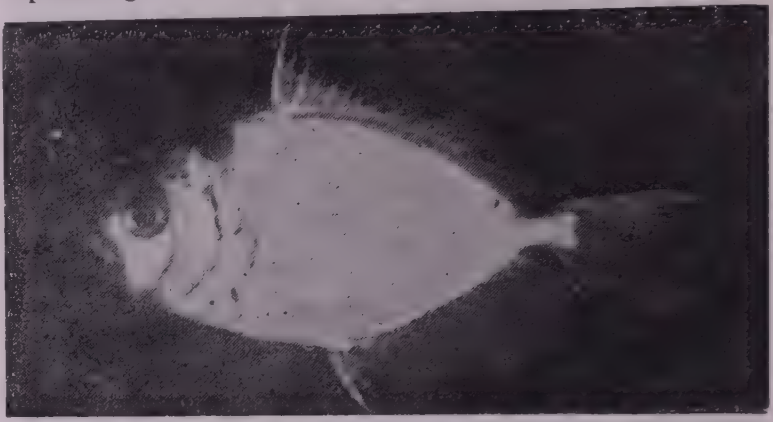

Fig. 23. *Leiognathus brevirostris.*

Scientific Name	:	*Leiognathus brevirostris*
Vernacular Name	:	'Mandai kaaral'
Gear	:	Trawl net/ Shore seine
Peak period of occurrence	:	Throughout the year
Depth of occurrence	:	12 - 15 m
Length range in commercial fishery	:	45 – 95 mm
Size at first maturity	:	Male : 68 mm Female : 63 mm
Spawning season	:	May. – Jun. and Oct. – Nov

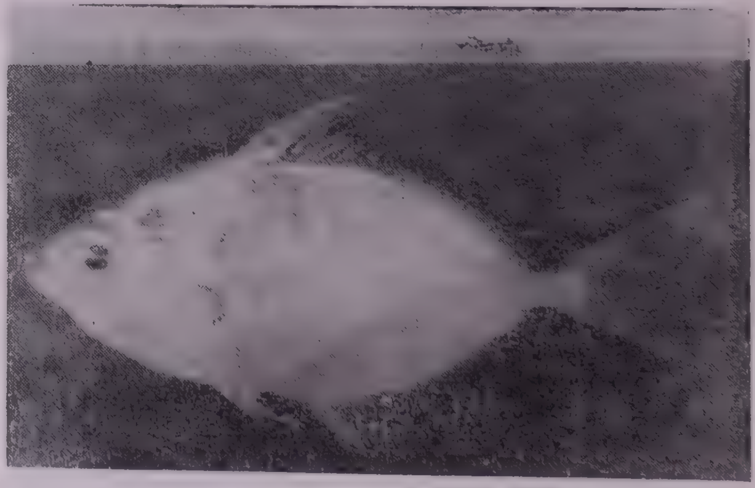

Fig. 24. *Leiognathus dussumieri.*

Scientific Name	:	*Leiognathus dussumieri*
Vernacular Name	:	'Vari kaaral'
Gear	:	Trawl net/Shore seine/ Gill net
Peak period of occurrence	:	Throughout the year

Depth of occurrence : 20–40 mm
Length range in commercial fishery : 40 – 90 mm
Size at first maturity : Males : 78 mm
Females : 83 mm
Spawning season : Apr. – May and Nov. - Dec.

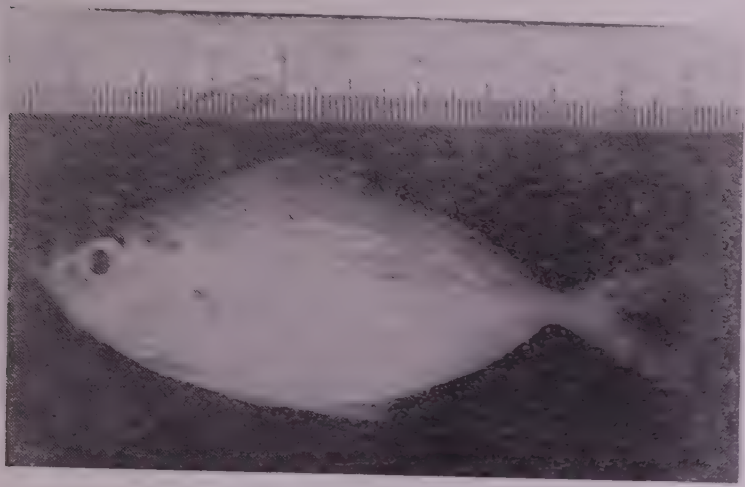

Fig. 25. *Leiognathus berbis.*

Scientific Name : *Leiognathus berbis*
Vernacular Name : 'Oosi kaaral'
Gear : Trawl net/Shore seine
Peak period of occurrence : Throughout the year
Depth of occurrence : 3–8 m
Length range in commercial fishery : 60 – 90 mm
Size at first maturity : —
Spawning season : —

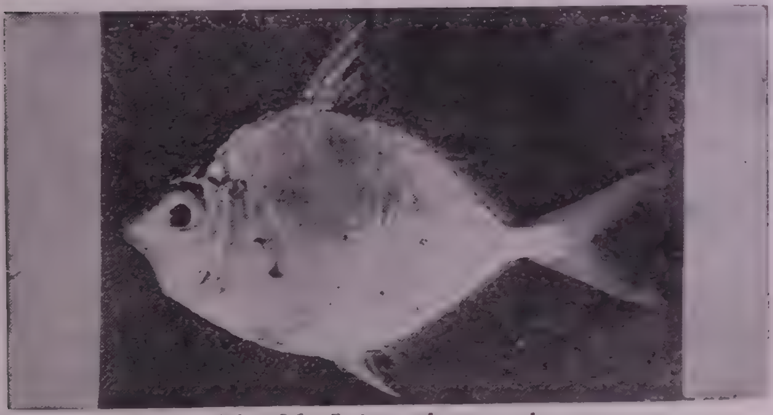

Fig. 26. *Leiognathus equulus.*

Scientific Name : *Leiognathus equulus*
Vernacular Name : 'Porumand kaaral'
Gear : Trawl net/Gill net
Peak period of occurrence : Throughout the year
Depth of occurrence : 10 - 25 m
Length range in commercial fishery : 125 - 200 mm
Size at first maturity : —
Spawning season : Jan. - Mar. and May

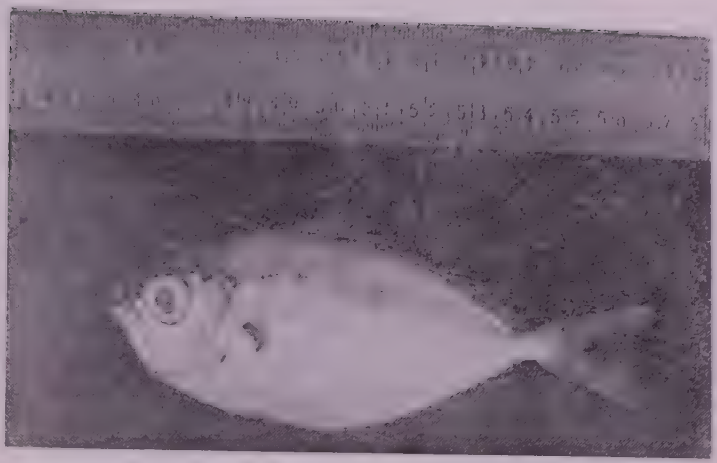

Fig. 27. *Gazza minuta.*

Scientific Name : *Gazza minuta*
Vernacular Name : 'Kuthipu kaaral'
Gear : Trawl net/Shore seine
Peak period of occurrence : Throughout the year
Area : Gulf of Mannar
Depth of occurrence : 7–20 m
Length range in commercial fishery : 45 – 115 mm
Size at first maturity : —
Spawning season : Jan. – Apr. and Aug. – Dec.

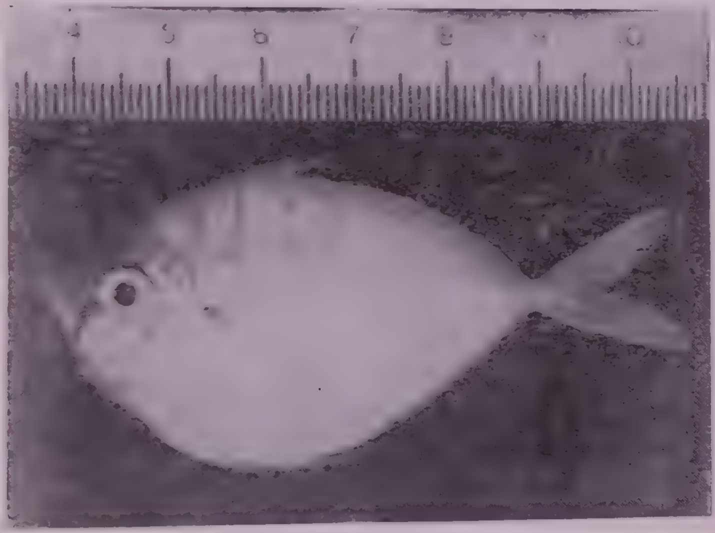

Fig. 28. *Secutor ruconius.*

Scientific Name : *Secutor ruconius*
Vernacular Name : 'Pottu kaaral'
Gear : Trawl net/Shore seine
Peak period of occurrence : Throughout the year
Depth of occurrence : 5 – 20 m
Length range in commercial fishery : 40 – 50 mm
Size at first maturity : 45 mm
Spawning season : Oct. – Dec.

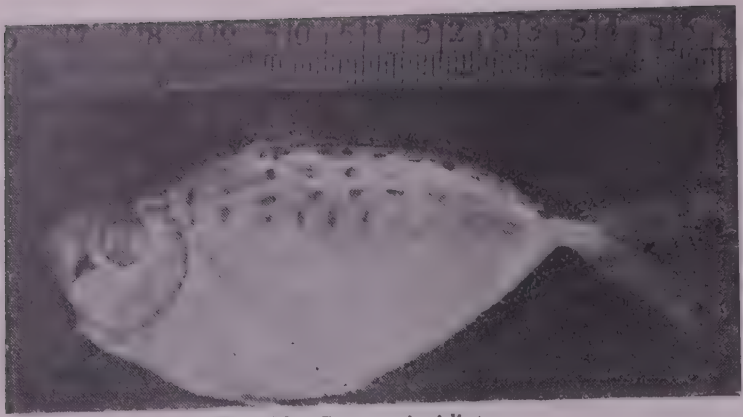

Fig. 29. *Secutor insidiator.*

Scientific Name : *Secutor insidiator*
Vernacular Name : 'Kaana kaaral'
Gear : Trawl net/Gill net
Peak period of occurrence : Throughout the year
Depth of occurrence : 7-20 m
Length range in commercial fishery : 15 – 85 mm
Size at first maturity : 70 mm
Spawning season : Oct. – Feb.

SCOMBRIDAE

Popular English Name : Indian mackerel
Vernacular Name (Tamil) : 'Kumula'
Annual average catch : 32 t
Percentage in total catch : 43
Fishing methods and their contribution : Drift gill net : 23% / Shore seine : 20%

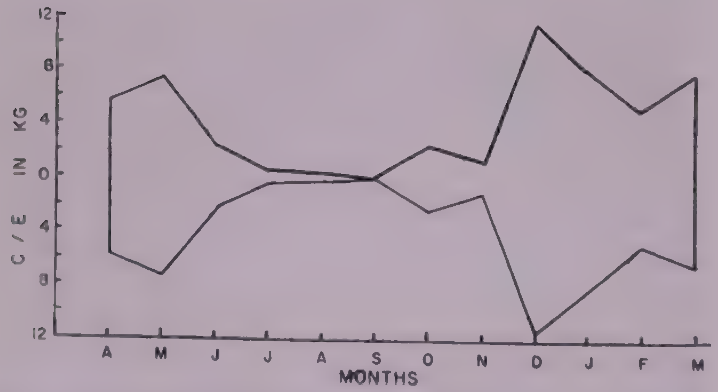

Fig. 30. Seasonal abundance of mackerel in the gill net fishery.

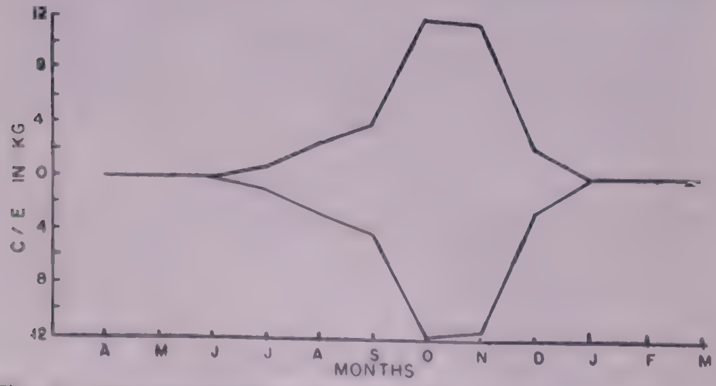

Fig. 31. Seasonal abundance of mackerel in the shore seine fishery.

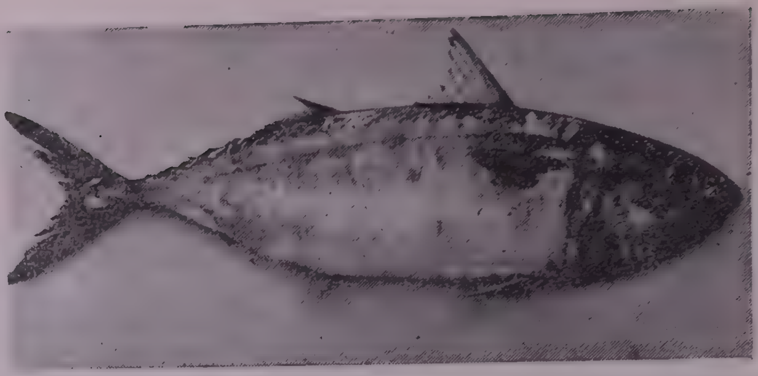

Fig. 32. *Rastrelliger kanagurta.*

Scientific Name : *Rastrelliger kanagurta*
Vernacular Name : 'Kumula'
Gear : Drift gill net/ Shore seine
Percentage in the catch of the group : 100
Peak period of occurrence : Sep. – Mar.
Depth of occurrence : 5 – 18 m
Length range in commercial fishery : 220 – 240 mm
Size at first maturity : —
Spawning season : Jun. - Jul. and Jan. – Mar.

SERRANIDAE, SIGANIDAE, SCARIDAE AND LETHRINIDAE

Popular English Name : Perches
Vernacular Name (Tamil) : 'Kalava'/'Oramin'/'Kilinjan'/'Velamin'
Annual average catch : 260.7 t

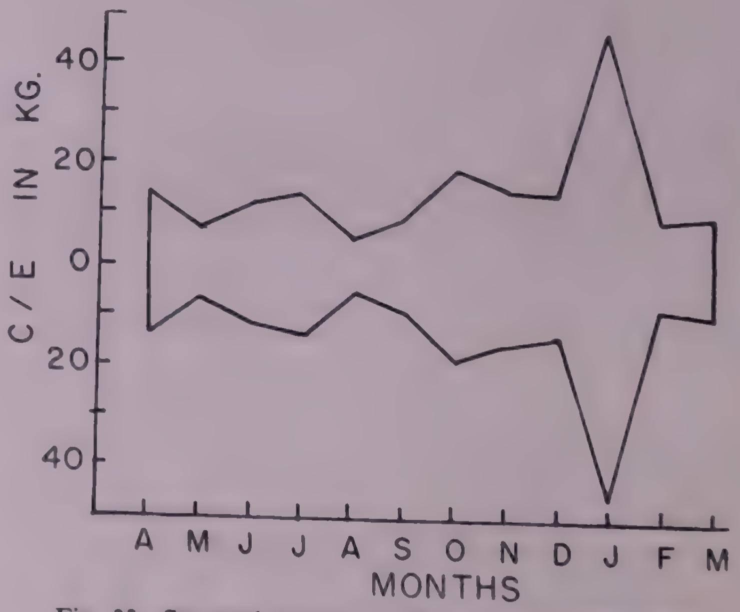

Fig. 33. Seasonal abundance of perches in perch trap.

Percentage in total catch : 0.46
Fishing methods and their contribution : Hooks & line : 80.9%
Trap : 19.1%

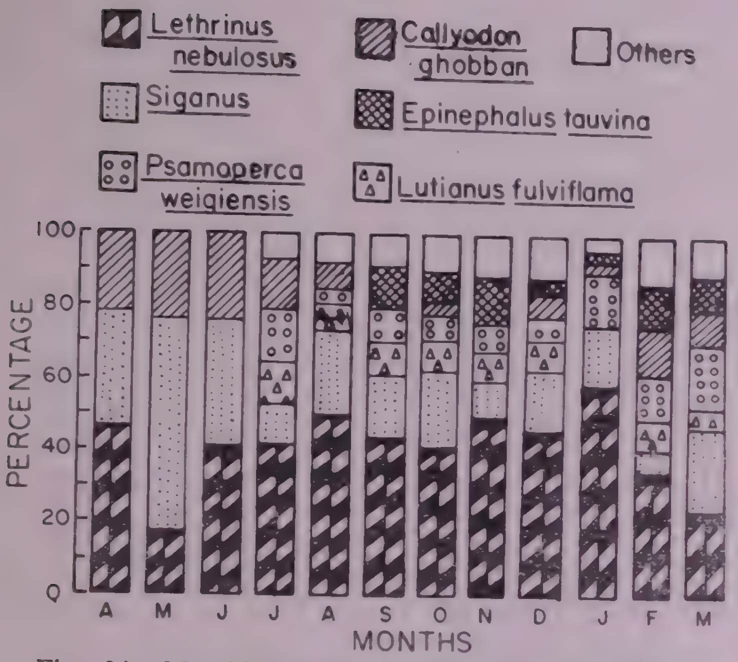

Fig. 34. Monthly species composition of perches in the perch trap.

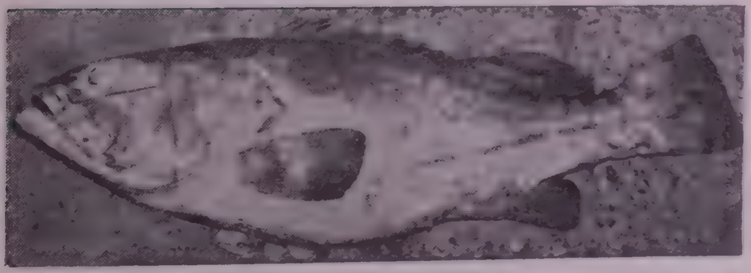

Fig. 35. *Epinephelus tauvina*.

Scientific Name : *Epinephelus tauvina*
Vernacular Name : 'Pulli Kalava'
Gear : Trap/Hooks & line
Percentage composition in the catch of the group : Trap : 3.9
Hooks & line : 16
Peak period of occurrence : Oct. – Mar.
Depth of occurrence : 10 – 30 m
Length range in commercial fishery : 180 – 790 mm
Size at first maturity : —
Spawning season : —

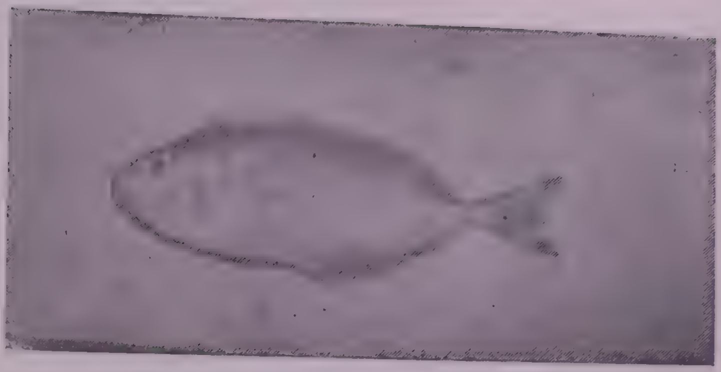

Fig. 36. *Siganus canaliculatus*.

Scientific Name : *Siganus canaliculatus*
Vernacular Name : 'Oramin'
Gear : Trap/Hooks & line
Percentage composition in the gear : Trap : 19.9
Hooks & line : 3.0
Peak period of occurrence : Oct. – May
Depth of occurrence : 2–5 m
Length range in commercial fishery : 150 – 300 mm
Size at first maturity : —
Spawning season : —

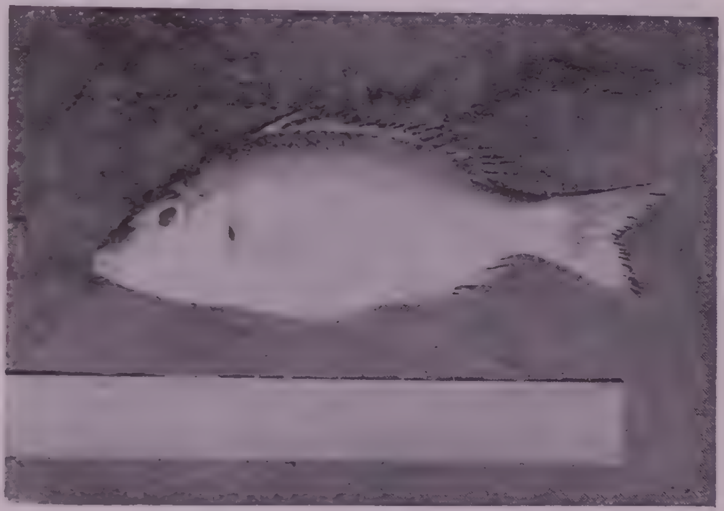

Fig. 37. *Lethrinus nebulosus*.

Scientific Name : *Lethrinus nebulosus*
Vernacular Name (Tamil) : 'Velamin'
Gear : Trap/Gill net/ Hooks & line/ Trawl net
Percentage composition in the catch of the group : Trap : 45.7
Gill net : 16.0
Hooks & line : 28.0
Peak period of occurrence : Oct. – Mar.
Depth of occurrence : 10 – 30 m

Length range in commercial fishery : 70 – 320 mm
Size at first maturity : —
Spawning season : —

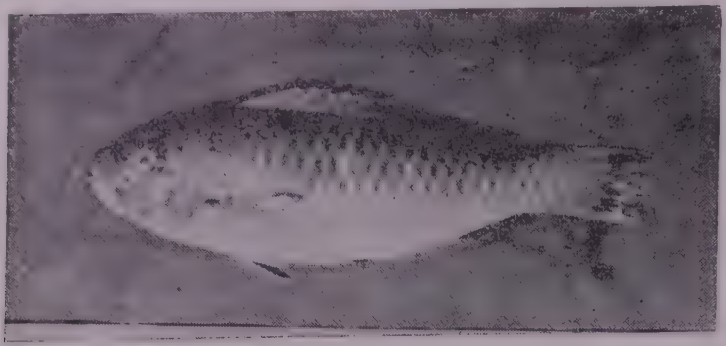

Fig. 38. *Callyodon ghobban.*

Scientific Name : *Callyodon ghobban*
Vernacular Name : 'Kilinjan'
Gear : Trap/Hooks & line
Percentage composition in the catch of the group : Trap : 8.9
Peak period of occurrence : Nov. – May
Depth of occurrence : 2 – 5 m
Length range in commercial fishery : 150 – 300 mm
Size at first maturity : —
Spawning season : —

MARINE FISH CALENDAR

XIII. MINICOY*

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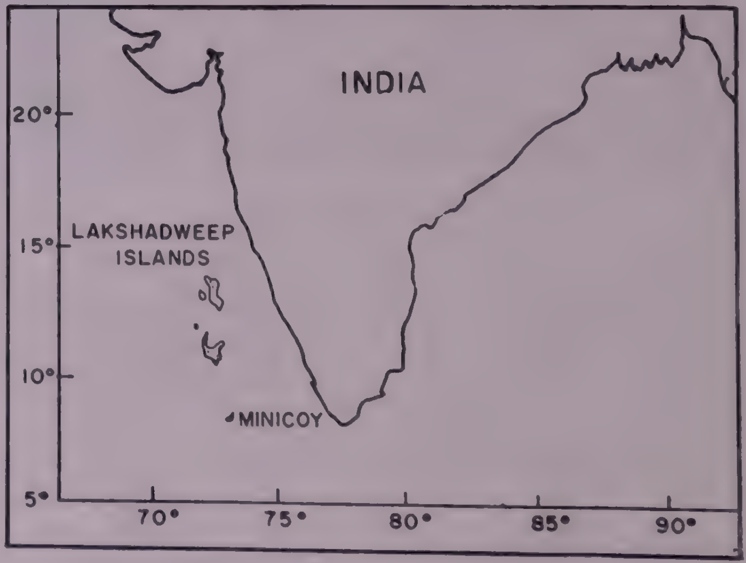
Minicoy Research Centre of CMFRI, Minicoy

Introduction

Despite the fact that tuna fishery at Minicoy (Long. 73° 00′ E, Lat. 8°17′ N) has been reported earlier, the seasonality of total marine fish production and trend of effort is little known. In view of this a 'Marine Fish Calendar' for Minicoy is presented here based on the data collected during April, 1984 to March, 1987.

Pole and line and surface trolling gears were responsible for about 95.85% and 4.14% respectively of the total fish landed; catch by hooks and line was negligible (0.01%). Trend of effort indicate that pole and line operations are more prevalent during post and premonsoon seasons, whereas maximum effort by troll line recorded was during monsoon months. Productive period for pole and line fishery is during October–May and for surface trolling June to September with a secondary maximum in February.

Pooled average C/E by pole and line fishery also indicate the same trend of that of the effort with primary peak during November-December and secondary one during March–April period. Catch per effort trend for troll line fishery was more or less uniform throughout the period eventhough maximum effort expended was during the monsoon months. High catch rate recorded during February was the reflection of the effort put in during February, 1986.



In the pole and line fishery, skipjack tuna *(Katsuwonus pelamis)* contributed, on an average, about 90% of the total marine fish catch. Yellowfin tuna *(Thunnus albacares)* represented by sub-adults (young) occurred mainly during the postmonsoon period. Other components of the catch included rainbow runner *(Elagatis bipinnulatus)*, little tuna *(Euthynnus affinis)*, dolphin fish *(Coryphaena hippurus)* and small pelagic sharks in their order of abundance.

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* Consolidated by N. Gopinatha Menon and K. Balachandran, CMFRI, Cochin.

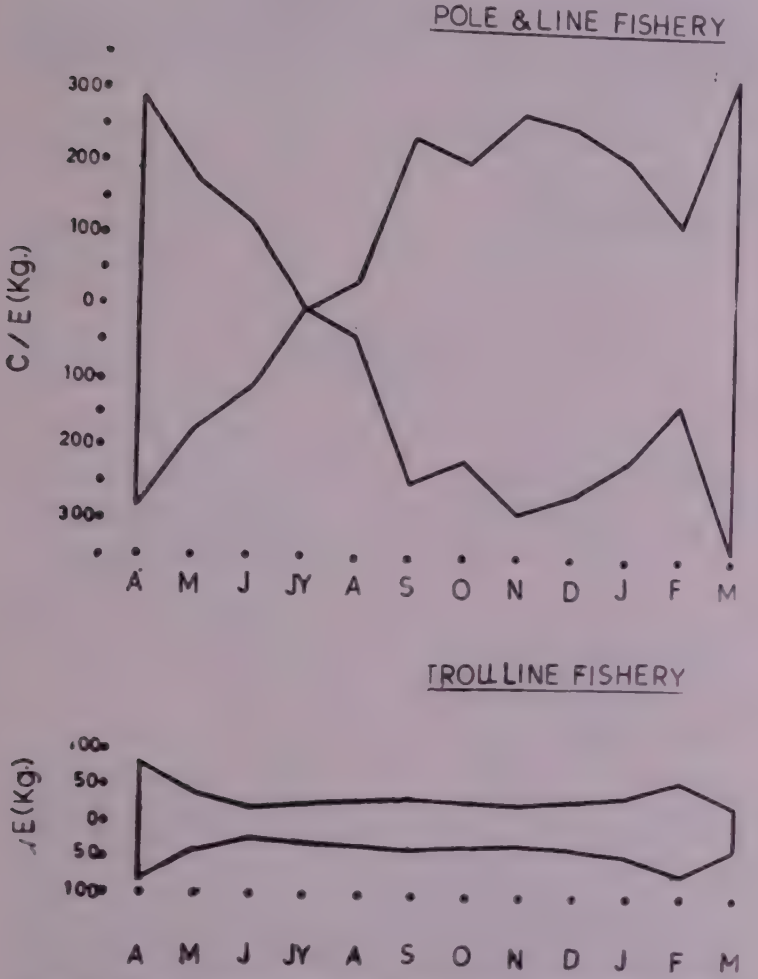

Fig. 1. Seasonal abundance of pole and line and troll line fishery at Minicoy.

Species diversity was high in the troll line catches; average annual pattern of occurrence of different species in their order of abundance was: yellowfin tuna (sub-adults 38.7%), skipjack tuna (23.5%), *Acanthocybium solandri* (wahoo) (10.4%), pelagic sharks (7.3%), *Istiophorus platypterus* (sail fish) (5.4%), *Caranx* sp. (3.9%), *Elagatis bipinnulatus* (2.3%), *Sphyraena* sp. (1.8%), *Euthynnus affinis* and *Auxis thazard* (0.4%), *Gymnosarda unicolor* (0.4%), *Coryphaena hippurus* (0.4%) and others (5.5%). A noticeable feature in the troll line fishery was the abundant occurrence of wahoo during postmonsoon months and young yellowfin tuna during premonsoon months.

Factors such as sea surface temperature, surface currents, wind pattern, availability and abundance of live-baits, tuna behaviour in the fishing ground and presence of floatsam objects exert considerable influence on the fluctuation in the availability of tunas which is the mainstay of marine fishery at Minicoy.

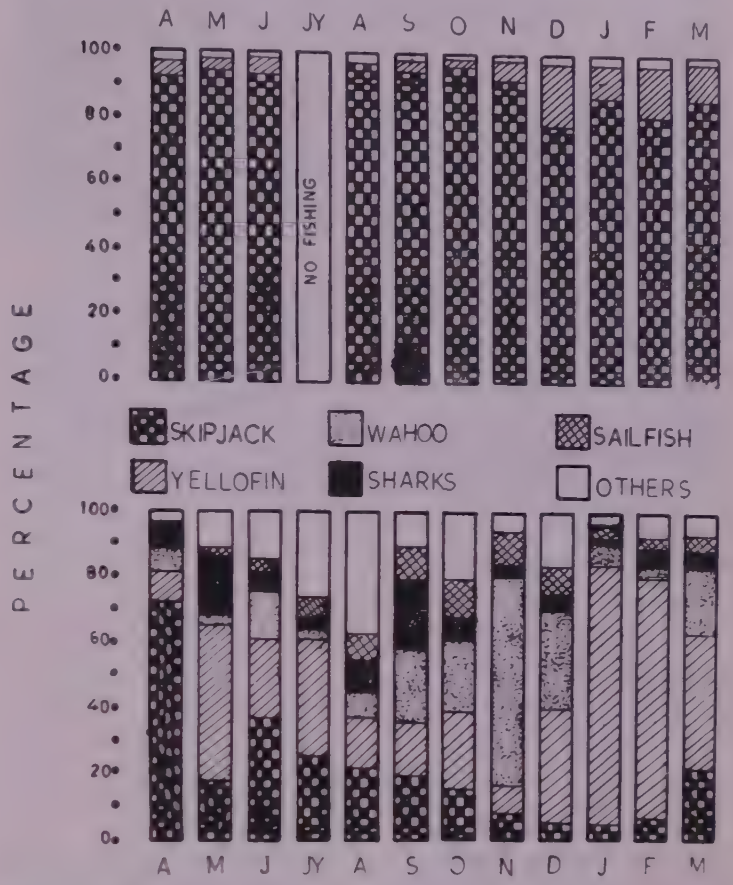

Fig. 2. Monthwise species composition of pole and line fishery and troll line fishery at Minicoy (upper panel – pole and line fishery and lower panel - troll line fishery).

CARANGIDAE

Popular English Name : Rainbow runner
Vernacular Name (Mahl) : 'Maniya'
Annual average catch : 2.44 t
Percentage in total catch : 0.37
Fishing methods and their contribution : Pole & line : 73.7%
Troll line : 26.3%

CORYPHAENIDAE

Popular English Name : Dolphin fish
Vernacular Name (Mahl) : 'Fiyala'
Annual average catch : 0.17 t
Percentage in total catch : 0.03
Fishing methods and their contribution : Pole & line : 100%

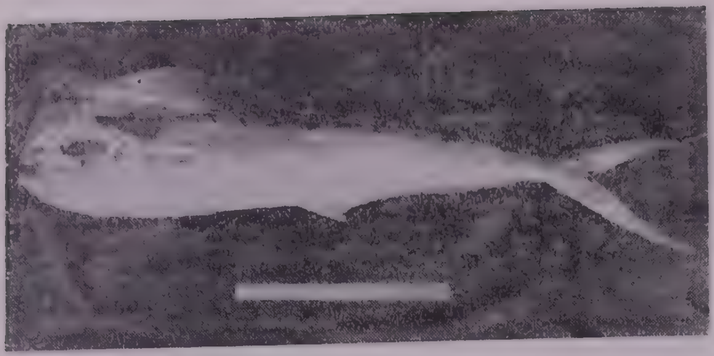

Fig. 3. *Coryphaena hippurus.*

Scientific Name : *Coryphaena hippurus*
Vernacular Name : ‘Fiyala’
Gear : Pole & line
Percentage in the catch of the group : 100
Peak period of occurrence : Nov.
Depth of occurrence : Surface
Length range in commercial fishery : 550 – 580 mm
Size at first maturity : —
Spawning season : —

GALEIDAE

Popular English Name : Sharks
Vernacular Name (Mahl) : ‘Katta fulimiaru’
Annual average catch : 2.12 t
Percentage in total catch : 0.33
Fishing methods and their contribution : Troll line : 95%
Pole & line : 5%

ISTIOPHORIDAE

Popular English Name : Sail fish
Vernacular Name (Mahl) : ‘Funhibaru’
Annual average catch : 1.50 t
Percentage in total catch : 0.23
Fishing methods and their contribution : Troll line : 100%

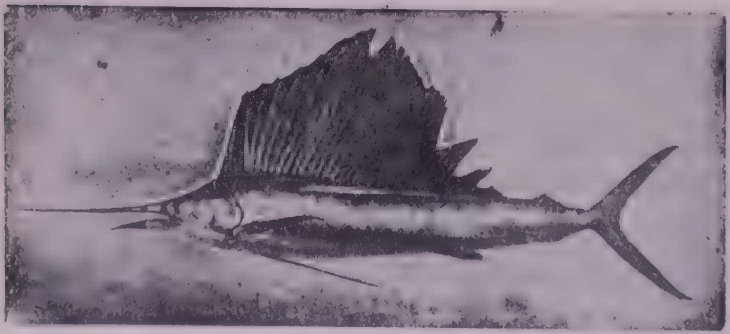

Fig. 4. *Istiophorus platypterus.*

Scientific Name : *Istiophorus platypterus*
Vernacular Name : ‘Funhibaru’
Gear : Troll line
Percentage in the catch of the group : 100
Peak period of occurrence : Jul. – Nov.
Depth of occurrence : Surface
Length range in commercial fishery : 700 – 1,250 mm
Size at first maturity : —
Spawning season : —

SCOMBRIDAE

Popular English Name : Tuna/Wahoo
Vernacular Name (Mahl) : ‘Kalibila’/‘Kannali’/‘Latti’/‘Ragondi’/‘Digu’
Annual average catch : 645.09 t
Percentage in total catch : 98.96
Fishing methods and their contribution : Pole & line : 96.9%
Troll line : 3.1%

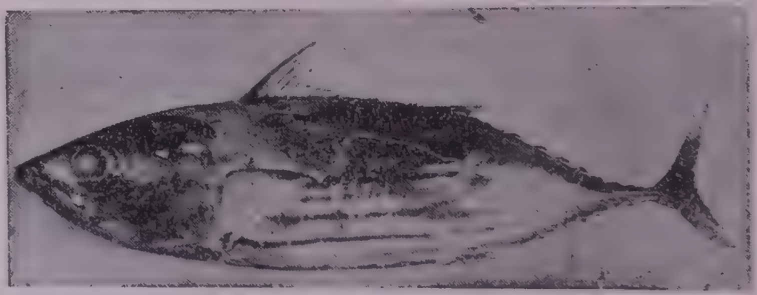

Fig. 5. *Katsuwonus pelamis.*

Scientific Name : *Katsuwonus pelamis*
Vernacular Name : ‘Kalibila’
Gear : Pole & line/Troll line
Percentage in the catch of the group : 88.60
Peak period of occurrence : Dec. – Apr.
Depth of occurrence : —
Length range in commercial fishery : 300 – 720 mm
Size at first maturity : 430 mm
Spawning season : Oct. – Mar. and May – Oct.

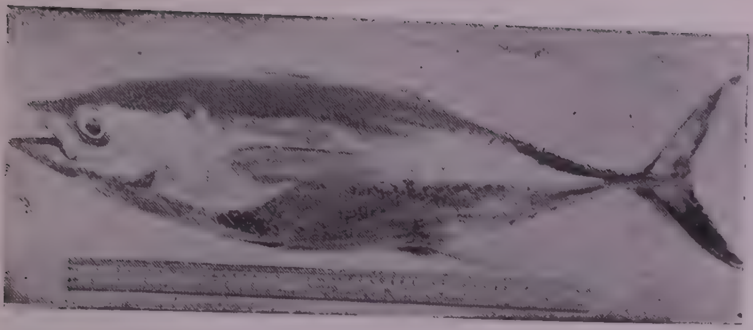

Fig. 6. *Thunnus albacares.*

Scientific Name : *Thunnus albacares*
Vernacular Name : 'Kannali'
Gear : Pole & line/Troll line
Percentage in the catch of the group : 10.79
Peak period of occurrence : Dec. – May
Depth of occurrence : Surface
Length range in commercial fishery : 320 – 1,020 mm
Size at first maturity : —
Spawning season : —

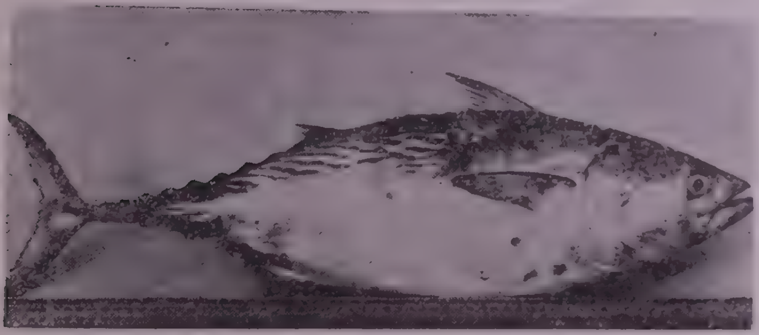

Fig. 7. *Euthynnus affinis.*

Scientific Name : *Euthynnus affinis*
Vernacular Name : 'Latti'
Gear : Pole & line
Percentage in the catch of the group : 0.13
Peak period of occurrence : Dec. – Apr.
Depth of occurrence : Surface
Length range in commercial fishery : 460 – 580 mm
Size at first maturity : —
Spawning season : —

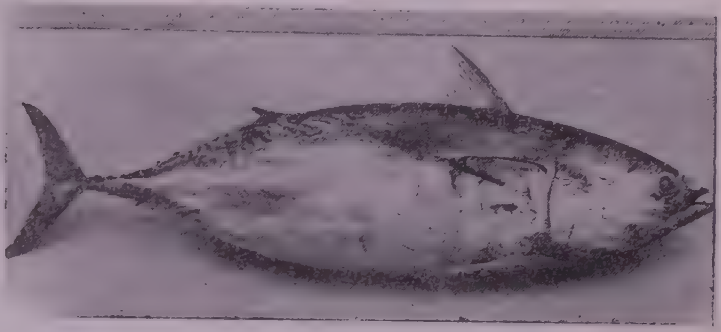

Fig. 8. *Auxis thazard.*

Scientific Name : *Auxis thazard*
Vernacular Name : 'Ragondi'
Gear : Pole & line/Troll line
Percentage in the catch of the group : 0.04
Peak period of occurrence : Dec. – Apr.
Depth of occurrence : —
Length range in commercial fishery : 350 – 370 mm
Size at first maturity : —
Spawning season : —

SPHYRAENIDAE

Popular English Name : Barracuda
Vernacular Name (Mahl) : 'Fandiarutholi'
Annual average catch : 0.51 t
Percentage in total catch : 0.08
Fishing methods and their contribution : Troll line : 100%

* * *

The author of article 2 in MFIS No. 88 for October, 1988 informs that the state-wise, quarter-wise and district-wise data for oil sardine landings have been compiled by Shri K. C. Yohannan of the Fisheries Resources Assessment Division of CMFRI.

—EDITORS

RECENT DEVELOPMENTS IN PRAWN AND FISH CULTURE IN ANDHRA PRADESH

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The pace of development in the brackishwater prawn culture and intensive fresh water fish culture in Andhra Pradesh from 1980 onwards has been phenomenal compared to other states in the country. The abundant water resources in the deltaic regions of the Godavari and Krishna rivers, the enterprising nature of the people, the insatiable demand for fresh water fish in West Bengal and the expanding export market for frozen prawns led to a virtual explosion in fish and prawn culture activities in the State. This tremendous pace of progress received a set back in the middle of August, 1986 when the flood waters of the Godavari breached the bunds of the culture ponds leading to the loss of fish and prawn stocks.

In this context, as members of a team constituted by the Indian Council of Agricultural Research, the authors toured during early September, 1986 the districts of East Godavari, West Godavari and Krishna with the objectives: (1) to prepare a contingent plan for fisheries development, particularly for brackishwater aquaculture and (2) to identify the areas where the fish farmers need assistance by way of inputs and technology so that the concerned agencies can render necessary assistance.

Brackishwater prawn culture

Since 1982 there has been rapid increase in the culture of tiger prawn *Penaeus monodon* in brackishwater ponds in the coastal areas of East Godavari, West Godavari and Krishna districts. Polekurru Estate and Amalapuram Taluk in East Godavari, Dharbarevu, Vemuladevi, Vempa, Dussumarru, Perupalem, Mutyala palli and Losari in West Godavari and Divi, Machilipatnam and Bantumilli taluks in Krishna District are the important areas where pawn culture ponds are developed. The estimated areas under prawn culture are given in Table 1.

Table 1. *Extent (ha) of brackishwater prawn farms*

Districts	Govt./ Co-op.	Private	Total
East Godavari	167.0	112.5	279.5
West Godavari	207.0	350.0	557.0
Krishna	15.0	318.8	333.8
Total	389.0	781.3	1,170.3

East Godavari: At Polekurru the prawn farms are being developed in the mangrove area, adjoining the brackishwater creeks which are rich in prawn seed resources. The seed of *P. mondon* are collected from these creeks and sold at Rs. 30–60/1,000. A very successful 30 ha pump-fed farm has achieved a production of 1,000 kg/ha/per crop of 7–8 months duration with an average of 650 kg/ha/crop. Here only one crop per year is feasible as the salinity touches > 40 ppt during the summer months. Prawn seed are stocked 50,000/ha and harvested at 25–30 g size. Ponds are fertilised with cow dung and superphosphate and the prawns are fed with blood clam meat, trash fish, dried prawn head waste *etc.*

The Bay of Bengal Programme (BOBP) had developed a 5 ha prawn farm at Polekurru and their experiment has highlighted the advantages of growing prawns in pump-fed ponds over tide-fed ponds in this region. In the Polekurru area there are about 1,000 ha of land that can be developed into pump-fed brackishwater ponds.

In Amalapuram Taluk, pump-fed brackishwater farms covering 40 ha have been developed by local entrepreneurs. Here the annual salinity ranges from 12 to 20 ppt and *P. monodon* collected from nearby creeks are stocked in the ponds and fed with rice bran, groundnut oil cake and cotton seed cake. The prawns, on harvest attained a size of 30–40 nos/kg and the production rate was low at 250 kg/ha/4 months. The low production may be due to the absence of animal protein in the feed given to the prawns.

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* Brackishwater fish farm, Central Institute of Fisheries Education, Kakinada, Andhra Pradesh.

** Freshwater fish farm, Central Institute of Fisheries Education, Balabhadrapuram, E.G. District, Andhra Pradesh.

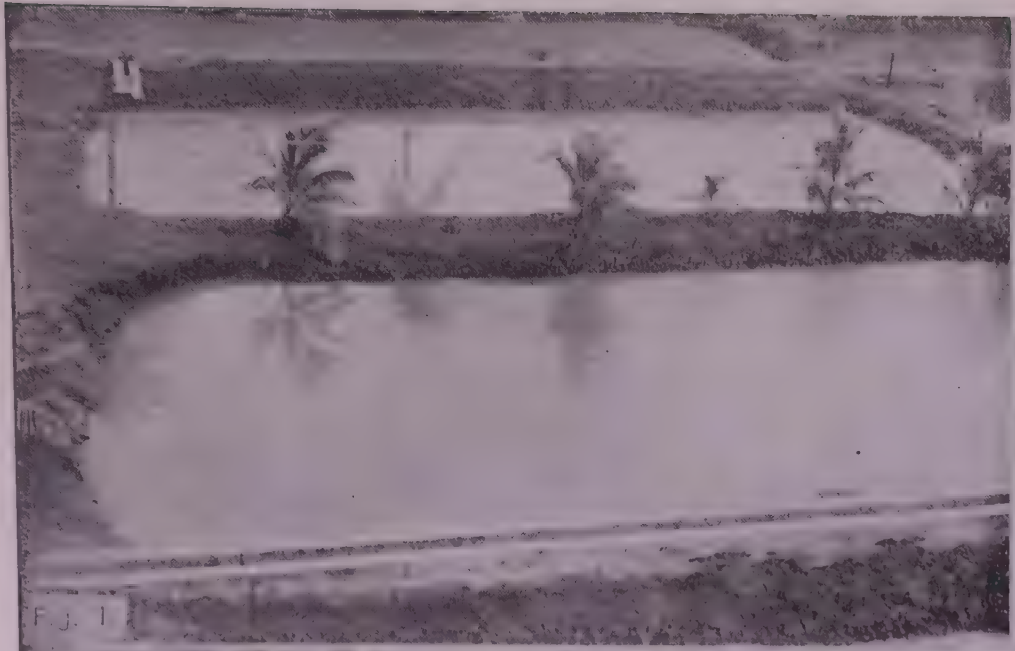


Fig. 1

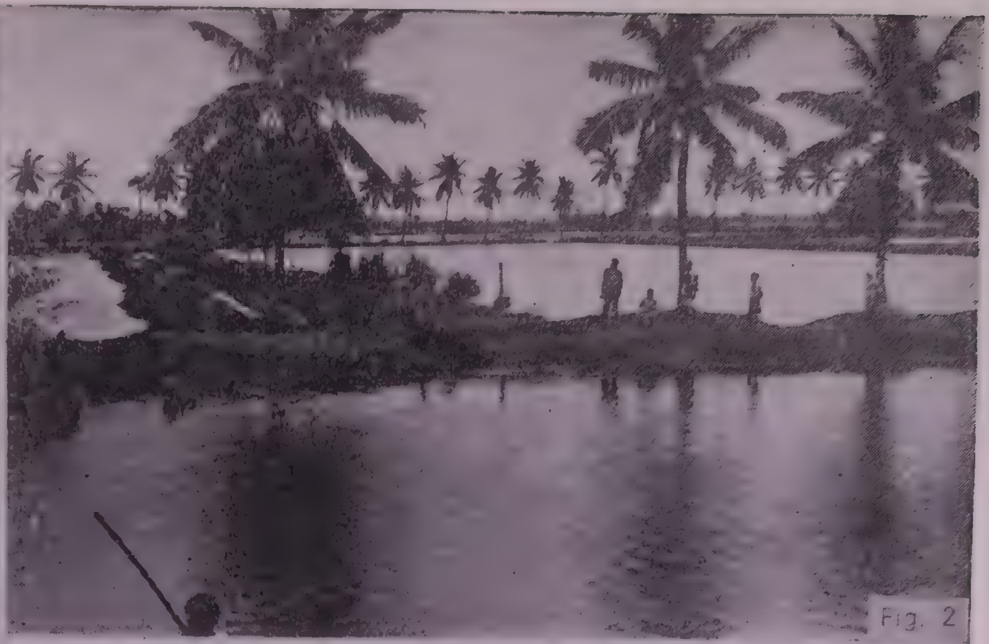


Fig. 2

Fig. 3

Fig. 4

Fig. 1. Nursery ponds for raising carp fingerlings in East Godavari District.
Fig. 3. Farmers show keen interest in learning about fish culture.

Fig. 2. Fish ponds bordering the agricultural drains near Bhimavaram.
Fig. 4. A large fish pond in Kolleru region.

West Godavari: In this district the areas adjoining the Gunupudi drain and Upputeru have saline soil and are not suitable for paddy cultivation. Hence the paddy field owners are rapidly converting them into prawn culture fields especially after an enterprising farmer of Dussumarru in 1982 obtained 250 kg of large (20–25 nos/kg head on) *P. monodon* in 4 months culture period from a 0.4 ha paddy field which was converted into a prawn culture pond. Since then, 300 ha of prawn ponds have sprung up in Chinnagaruvu, Vempa, Dussumarru and Perupalem. All these ponds have been developed by the agriculturists with their own resources. The ponds vary in size from 0.5 to 3.0 ha and have a 10 m wide and 60 cm deep peripheral trench and a central platform. The ponds are pump-fed, maintaining a depth of 30 to 60 cm over the platform and 90 to 120 cm in the trenches. Cement pipes fixed in the bunds are used for draining the ponds. The cost of construction is said to be Rs. 12,500–15,000/ha. The problem with this area is that the prawn production depends on the salt content of the soil rather than the salinity of the water which is almost fresh except during May–June when it is around 5–10 ppt. After the first food crop in 1982 prawn production declined in succeeding years to 200–250 kg/ha/crop mainly due to loss of soil salinity by leaching. This problem can be overcome by utilizing the sub-soil water (which is found to be brackish even during the monsoon season) to replenish the ponds when the drain water is almost fresh. At Dussumarru, from another 3 ha pond from which people were taking freshwater for drinking purposes, the authors collected 12–15 cm size *P.monodon.* The pond was not stocked with prawn seed, but was totally submerged during the floods. This was a remarkable example of *P. monodon* surviving in freshwater ponds where the soil is slightly saline.

The 207 ha District Rural Development Agency (DRDA) project established at Vemuladevi near Narsapur in 1980–'81 has not progressed well due to wrong selection of site, defective construction and lack of co-operation from the beneficieries. The ponds are now not in proper condition.

Krishna: In Machilipatnam Taluk, at Tallapaleru there are 3 ha of ponds under the Marine Products Export Development Authority (MPEDA), 12 ha under DRDA project and another 30 ha to be developed by the same agency. At Kanur-Pedapatnam, on the banks of the Lasbandha creek about 72 ha of mangrove area is to be developed into prawn ponds under the centrally sponsored scheme for the weaker sections. In the neighbourhood, private parties are developing another 40 ha of lands into prawn culture ponds. Abundant prawn seed, both of *P. monodon* and *P. indicus* are collected from the creeks and the peak periods of abundance of the seed of *P. monodon* are July–August and October–November.

In Divi Taluk the private farmers have constructed about 100 ha of prawn ponds and are culturing *P. monodon.* In Machilipatnam and Divi taluks the average production rate is 350 kg/ha/4–5 months in the case of *P. monodon* (20–25 g harvest size) and 450 kg/ha/4 months for *P. indicus* (12–15 g harvest size).

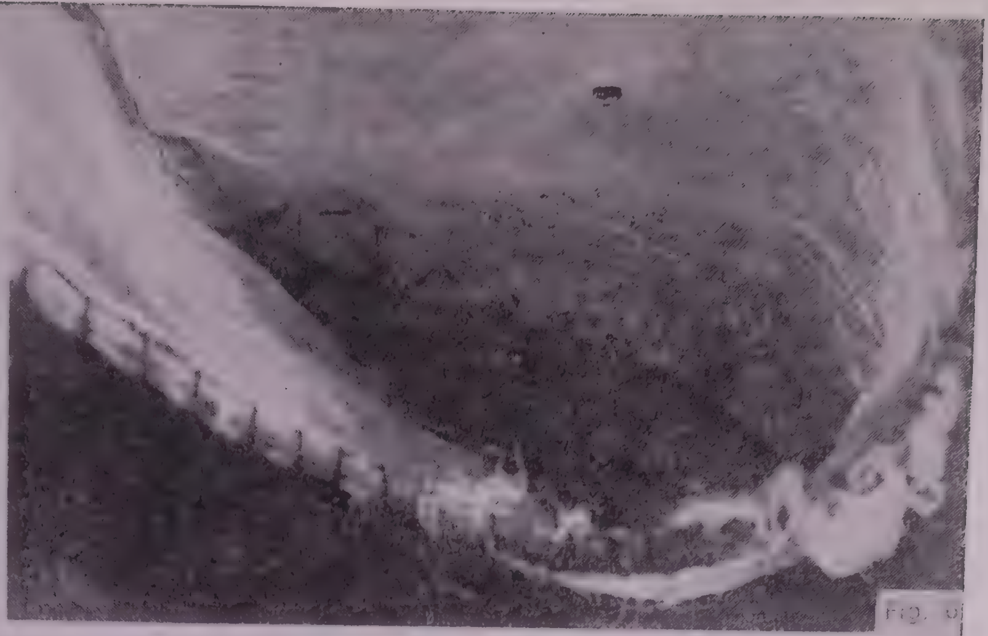
In Bantumilli Taluk, adjoining the Pedalanka drain the agriculturists are developing about 200 ha of land into prawn farms. The soil is saline and unsuitable for paddy cultivation and the salinity of the water in the Pedalanka drain ranges from 0–15 ppt. The ponds vary in size from 1–3 ha and are pump-fed. An interesting case of *P. indicus* culture in low salinity ponds is reported from this area. A farmer of Moolalanka village cultured *P. indicus* in a 1.6 ha pond for 4 months when the salinity in the pond was only 4.5 ppt. The prawns were stocked as 10 mm postlarvae and fed with cotton seed oil cake and rice bran. The harvest of *P. indicus* was 800 kg of size 50 - 80 nos/kg head on.

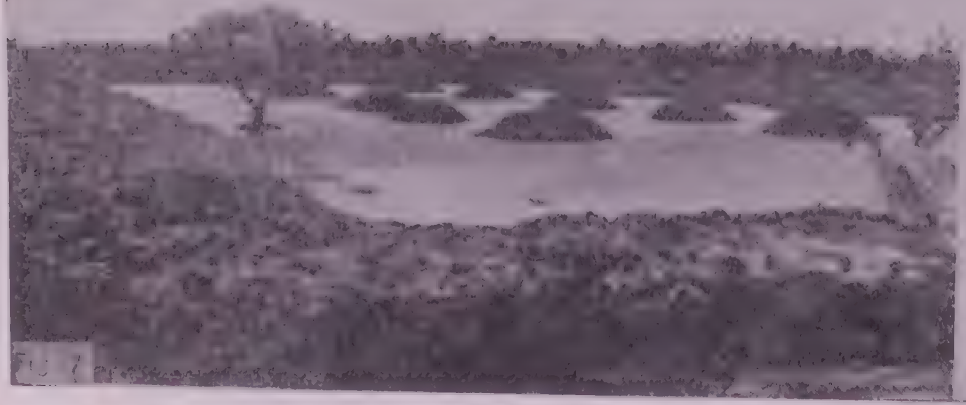
Freshwater fish culture

In the three districts there are no statistics regarding the acerage under freshwater fish culture. Based on enquiries it is estimated that atleast 30,000 ha of freshwater fish ponds have been developed in the state. There are about 150 fish seed farms covering about 250 ha in the private sector.

In the Kolleru Lake alone 869 ha under co-operative sector and about 10,000 ha in the private sector have been developed for freshwater fish culture.

The paddy fields adjoining the major irrigation canals in these districts are generally water logged during the major part of the year and are less productive than the neighbouring paddy fields. The farmers have converted these water logged fields into fish ponds by digging peripheral trenches (10–15 m wide and 1 m deep) and utilising the dug up soil to construct the bunds, thus minimising the cost. The undisturbed central portion of the pond remains as the platform over which 90 cm of water is maintained by pumping from the irrigation canals. The 180 cm water in the peripheral





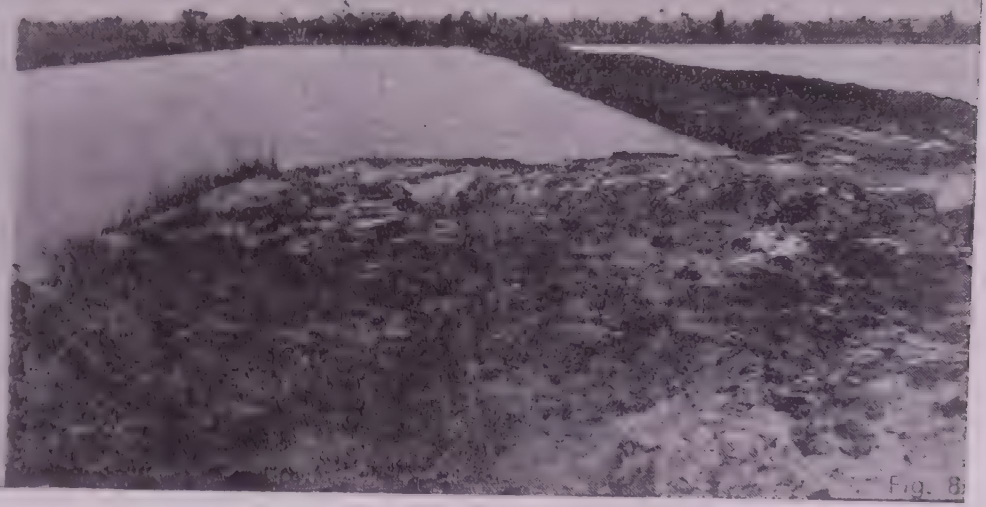


Fig. 5. Tiger prawn seed being collected from backwater creek near Perupalam.
Fig. 7. A prawn pond with heaps of excavated earth inside the pond to reduce cost of construction.

Fig. 6. Tiger prawn seed in a dip net.
Fig. 8. Prawn ponds in Bantumilli.

trenches provides protection to the fish from high temperature in summer. The fish are fed with a mixture of rice bran, deoiled rice bran and cotton seed oil cake/ground nut oil cake. The feed is kept in bags (used for fertilizers) with holes burned in them. The bags are tied to poles planted in the ponds. The fish ponds vary in size from 1–20 ha. The larger ponds are in the Kolleru Lake.

Many private fish seed farms in the three districts have hatcheries for fish spawn production through induced breeding of major carps and common carp. Breeders are maintained in large, 2.4 to 3 m deep ponds. Depending upon the magnitude of the operation, the farmers use simple hapas, tin jar hatcheries or Chinese type hatcheries for producing the spawn. The hatchery operations are confined to about two months from the middle of June to the middle of August, when the breeders become mature.

The spawn is purchased by the small farmers from the hatcheries and reared to 20–30 mm length in nurseries for about a month and then sold to the fish farmers. This has become a very lucrative business for small farmers, since the inputs and the risks are minimal. The farmers rear them in the rearing ponds upto the fingerling stage and then either sell them to other farmers or stock them in their grow-out ponds. To get the maximum price the farmers maintain the fingerlings in the rearing ponds in a stunted condition throughout the year and transfer them to the grow-out ponds when they are 200–500 g in size. The large yearlings are stocked in low densities (1,500–2,000/ha) in the grow-out ponds so that they attain a marketable size of 1.5–2 kg within a period of eight months. Production from the well managed ponds amounts to 5,000 kg/year. Average production is around 3,000 kg/ha/year. All the fish farmers are dependent on the Calcutta market where the wholesale price of fish is around Rs. 40/kg during the festival season. Fish are packed in ice in baskets and transported by road to Calcutta; the journey takes 36-40 hrs.

In short, fish farming in these three districts has became a well organised and lucrative industry with different groups of people specialising in activites such as hatchery production of seed, nursery rearing and farming the fingerlings to marketable size.

Technical inputs required by the farmers

Apart from the state government, which is primarily concerned with the developmental activites through the co-operative sector, the MPEDA and the Central Institute of Fisheries Education (CIFE) have in no small measure contributed to the development of aquaculture in the three districts of Andhra Pradesh. For prawn culture, the former is extending assistance to farmers in the preparation of project reports, providing subsidy for pond construction, monitoring the culture ponds and rendering technical assistance. The CIFE is conducting training courses to the private farmers and those covered by the co-operative sector giving them technical guidance both in brackishwater prawn and fresh water fish culture. Nevertheless, to sustain the excellent progress made the following technical inputs are the urgent need of the hour.

Inputs for prawn culture

At present the farmers are dependent on the seed collected from the wild. The supply is irregular and the farmers are at the mercy of a few people who have monopolised the prawn seed collection and charge exhorbitant prices. Also the prawn seed are not sorted out properly and are usually mixed with the seed of predatory fishes such as *Lates, Elops etc.* Hence there is an immediate need to set up prawn hatcheries along the coast to meet the great demand for prawn seed. The Andhra Pradesh State Fisheries Department, CMFRI and MPEDA are seized of this problen and have taken steps to establish prawn hatcheries in the State. The CMFRI has developed the technology indigenously for hatchery production of prawn seed.

The next important input for promoting prawn culture is to produce prawn feed in pellet form economically by utilizing locally available inexpensive raw materials. At present vast majority of the prawn farmers, following the practice of the freshwater fish farmers, are feeding the prawns with a mixture of rice bran, deoiled rice bran, groundnut oil cake and cotton seed oil cake. This vegetarian diet is not sufficient for the prawns which are mixed feeders and injest a substantial amount of animal matter under natural conditions. By incorporating animal protein in the diet the growth of the prawns can be accelerated. We have very little information on the nutritional requirements of the prawns and the conversion ratio of the existing conventional feeds. The CMFRI made some progress in this direction and has evolved practical diets for postlarvae, juveniles and adult prawns. However, there is need to intensify this work and evaluate the feeds under field conditions prevailing in Andhra Pradesh. There is also a pressing need for establishing a prawn feed mill in this area.

With the development of intensive prawn culture in this region outbreak of prawn diseases should be expected. The authors noticed a few cases of prawn diseases during their visit. On prawn diseases only a beginning has been made in the research effort in our country and this needs to be strengthened.

At present the CIFE and MPEDA are providing technical guidance to the prawn farmers in the state. To cope up with the rapid increase in the area under prawn cultivation it is necessary to strengthen the extension activities of these organisations so as to render timely technical advice to the farmers in pond management.

Large quantities of freshwater prawn seed *(Macrobrachium malcomsoni)* are collected from the anicuts on the Godavari and Krishna rivers. Currently the seed are not utilised for culture purposes to any notable extent and bulk of them is sundried. This resource can be very effectively used for culturing them either in monoculture or along with carps in freshwater ponds of Vempa-Dussumarru region where the soil is saline. The possibility of culturing *Macrobrachium* in this area, utilising the natural seed resources, needs to be explored.

Inputs for fish culture

It was observed that carp seed production in the three districts of Andhra Pradesh has attained a high level of proficiency in the Government and private sectors. The fish seed farms are able to cater to the needs of the farmers. However, there is great demand for *Catla* seed which is not produced in adequate quantities. The main constraint in this direction is the non-availability of good *Catla* breeders. As it takes more than three years for *Catla* to attain maturity, the farmers should be advised by extension agencies to retain sufficient number of fish as brood stock and rear them in deeper ponds.

As in the case of brackishwater prawn culture, the farmers are utilizing deoiled rice bran, rice bran, cotton seed oil cake and ground nut oil cake in varying proportions during the different growth phases of the cultured fish. There is need to evaluate the effectiveness of the prevailing practices and to develop a more suitable feed to accelerate the growth, reduce the culture period and maximise production. The present practice of fertilising the ponds to increase natural productivity should also be critically examined and improved upon where needed.

The freshwater fish grown in the Kolleru region are known to be sometimes heavily infested with ectoparasites such as *Lernea, Argulus etc*. They are also susceptible to fin rot and other diseases. The farmers are presently applying pesticides like 'Nuvan' indiscriminatey to treat the infested fish. The long range effects of this practice are not known. This problem needs to be investigated urgently.

Prospects of culturing airbreathing fishes such as *Clarias batrachus* in parts of Kolleru Lake which are not suitable for carp culture need to be investigated, since the seed of the above species are said to be locally available. *Clarias* is known to thrive well even in waters with heavy organic pollution and commands a good price in the Calcutta market. Some private farmers in Kolleru have already shown interest in culturing *Clarias* in raceway systems.

A large number of fish farmers have requested the authors that they need a cell established in proximity which would monitor the physical, chemical and biological parameters of the soil and water of freshwater fish ponds in the Kolleru region, where intensive fish culture is practised. This assumes significance because the value of the estimated carp production from the Kolleru Lake works out to several crores of rupees.

It was observed that the fish harvested from the culture ponds in the Kolleru Lake are transported to Calcutta mainly by road. It takes 40–50 hours for the iced fish from the grow-out ponds to reach the Calcutta market. It is necessary to evaluate the quality of the fish under the present system of preservation and transport and to improve the system, if necessary.

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